JUNE, 1941.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

902. The Bohr theory of nuclear reactions. R. Peierls. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 87–106, 1941.

903. Eleventh report of the committee on atomic weights of the International Union of Chemistry. G. P. Baxter, M. Guichard, O. Hönigschmid and R. Whytlaw-Gray. *J. Amer. Chem. Soc.*, **63**, *pp.* 845–850, *March*, 1941.

904. Valence effect in the electrophoresis of proteins computed by the Gronwall and La Mer theory. M. H. Gorin. *J. Phys. Chem.*, **45**, *pp.* 371–377, *March*, 1941.—The correction due to the approximation $\sinh e\zeta/kT = e\zeta/kT$ used in deriving the equation $v = v_o/(1+\kappa r)$ for electrical mobility is considered by the application of the third-order Gronwall La Mer correction to the equations for the electrical mobility of spherical molecules. It is shown that this correction increases as the square of the charge Q and the inverse square of the radius r of the protein at a given ionic strength ; also, for given Q and r the correction is a complicated function of the ionic strength. Results are discussed in relation to the work of Tiselius and Svensson on egg albumin [Abstr. 304 (1940)]. N. M. B.

905. Synthetic aniline-formaldehyde resins. W. Scheele, I. Avisiers and N. Ellerbroek. *Kolloid Zschr.*, **93**, *pp.* 1–19, *Oct.*, 1940. *In German.*—The method of preparation of the resins is described and from viscosity measurements at various temperatures and concentrations the molecular structure is deduced. The voluminosity factors for solutions in cresol at various concentrations and temperatures are determined and the values compared with those obtained with phenolic plastics. The authors conclude that the aniline-formaldehyde resins contain corpuscular molecules which may consist of molecular chains rolled up in some way. R. N.

906. Constitution of diluted soap solutions. III. Theory of hydrolysis. P. Ekwall. *Kolloid Zschr.*, **92**, *pp.* 141–157, *Aug.*, 1940. *In German.*—A recent theory [Abstr. 448 (1937)] replacing older conceptions assumes that the fatty-acid ions of soap solutions are gradually associated and that double ions are hydrolysed more easily than single, and multiple ions more easily than double, ions. A new product of hydrolysis is formed only when the anion association reaches a new step. This theory is improved in certain details in the present paper. In different stages of concentration different products of hydrolysis are formed. The hydrolysis curve is composed of separate parts each with its own balance of hydrolysis; within each part the trend of the curve is determined by the degree of association, the hydrolysis constants and the solubility of the product of hydrolysis. The corresponding equations are derived from which the activity of the hydroxyl ions or the degree of hydrolysis may be predicted. R. N.

907. Water bound to gelatin as shown by molecular-structure studies. O. L. Sponsler, J. D. Bath and J. W. Ellis. *J. Phys. Chem.*, **44**, *pp.* 996–1006, *Nov.*, 1940.—Three lines of investigation on gelatin hydration are reported. (*a*) Agreement is shown between the number of coordinate water molecules potentially possible in a 35% water 65% protein system and the number computed to be present. (*b*) The location and distribution of the water molecules on the gelatin chain molecule is shown by X-ray analyses. (*c*) The manner in which the water molecules are bound to the protein chain is shown by infra-red absorption to be, probably, through H bridges. N. M. B.

908. Solvents and the structures of cellulosic sheets. J. Spence. *Kodak Res. Lab. Commun. No.* 767. *J. Phys. Chem.*, **45**, *pp.* 401–410, *March*, 1941.—Sheet materials are formed by the reorganization of long-chain molecules or their aggregates on removal of the dispersion medium. In this study of the birefringence and X-ray diffraction of cellulosic sheets it is shown that the influence of the medium may be characterized in terms of the extent and nature of the intracrystallite organization. In particular, it is demonstrated that, in certain cases, the quantitative expression of the optical anisotropy is a measure of the long-chain molecular order-disorder balance, and, as such, may be related to the mechanical properties of the sheet. Author.

***909. New mass spectrograph and the isotopic constitution of Ni.** H. A. Straus. *Phys. Rev.*, **59**, *pp.* 430–433, *March* 1, 1941.—A new double focusing mass spectrograph which has a 90° electric field and a 60° magnetic field has been constructed and used to determine the isotopic constitution of Ni. The instrument and the null method of measurement are described. Author.

COLLOIDS.

910. Viscosity and the nature of substances of high molecular weight in solution. F. Eirich. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 329–354, 1941.

911. Investigations on the strength of aerosol sediments. Orderly coagulation of aerosols. III. D. Beischer. *Kolloid Zschr.*, **89**, *pp.* 214–219, *Nov.*, 1939. *In German.*—[See Abstr. 3336 (1937)]. The author describes methods for determining by experiment the strength of threads formed of sediments of colloidal particles in a gaseous medium. The values thus obtained are compared with those calculated under the assumption of the exclusive presence of London and van der Waals forces. There is partly agreement between experimental and theoretical values. Where this is not the case it is assumed that either the particles are cemented together by surface diffusion or that they are under the influence of additional Coulomb forces. [See Abstr. 3955 (1936) and 1420 (1937).] R. N.

912. Surface activity of some sodium sulphonate solutions and the chemical constitution of the hydrocarbon residue. N. Turkiewicz. *Kolloid Zschr.* **92**, *pp.* 208–217, *Aug.*, 1940. *In German.*—Tables are given showing the foam-forming conditions for some sodium sulphanates and the surface tension as function of concentration. Naphthene sulphonates in which the sulphone group is primarily bound are easily soluble, crystallizable and capillary active. Cyclopentane and cyclohexane derivatives are compared. The greatest surface activity is obtained when the sulphonates are prepared by replacing the carboxyl group in naphthalenic acid by the group CH_2SO_3Na. R. N.

913. Non-isothermal gel-sol-gel transformation of mixed gelatin-methylcellulose systems. W. Heller. *J. Phys. Chem.*, **45**, *pp.* 378–388, *March*, 1941.—Methylcellulose and gelatin hydrosols form coacervates when mixed with each other. The methylcellulose and gelatin phases formed behave largely independently of each other, the former setting to a gel at high temperatures, the latter forming a gel at low temperatures. The only perceptible interaction between methylcellulose and gelatin is a dehydration of the former by the latter. Dispersion of the two phases in each other, by shaking, leads to systems which show a gel-sol-gel transformation with rising temperature; at low temperatures a gelatin gel structure can include up to 85% by vol. of methylcellulose sol without depriving the mixed system of its gel character; at high temperatures a methylcellulose gel structure can include up to 30% by vol. of gelatin sol. The gel-sol-gel transformation is largely independent of the *p*H. Author.

914. Activity coefficients of silver and chromate ions in gelatin media. A. van Hook. *J. Phys. Chem.*, **45**, *pp.* 422–431, *March*, 1941.—The apparent individual activity coefficients of silver and chromate ions, in aqueous media and in 1·5% and 3% gelatin media, have been determined. Gelatin-silver ion combination is extensive but diminishes as the *p*H value of the medium decreases below the iso-electric point. Chromate ion also combines extensively with gelatin, but approaches more nearly Loeb's idea of the iso-electric point as a critical *p*H. The silver ion and gelatin combination is quantitatively described by the Freundlich adsorption equation. Author.

915. Measurements of the breaking strength of lyogels. C. R. Bailey. *J. Phys. Chem.*, **45**, *pp.* 493–500, *March*, 1941.—A gel-forming mixture consisting of 3·03% clay, 0·54% K_2SO_4 and 96·43% distilled water was chosen for studying the rate of development of breaking torque. The procedure consisted in thoroughly beating the mixture in an electric mixer, placing it in the apparatus where it was allowed to set for an arbitrarily determined length of time in a saturated atmosphere at 20°C., and then measuring the breaking torque. The same gel was used repeatedly. The log of the breaking torque plotted against time allowed for setting gives a straight-line locus. There is an intercept value of breaking torque equal to 47 cm.g. Equilibrium was reached at a breaking torque value of 95+ cm.g., corresponding to a setting time equal to 13·2+hr. Author.

916. Studies on hydrogel of titania. I. Effect of temperature on time of set. C. B. Hurd, W. J. Jacober and D. W. Godfrey. *J. Amer. Chem. Soc.*, **63**, *pp.* 723–725, *March*, 1941.—These gels are softer than silicic-acid gels of equivalent concentration. They also break down on standing, giving a granular precipitate. The energy of activation is higher than that for silicic-acid gels. Acidic mixtures set more rapidly with increases in the *p*H, the titania content or the temperature. Gels which had set at a higher temperature were liquefied by rapid cooling. Authors.

917. Polymerization of tung oil. V–VI. M. Tatimori. *Bull. Chem. Soc. Japan*, **16**, *pp.* 45–59, *Feb.*, 1941.—

918. Transition from anatase to rutile and the influence of the presence of HCl gas. G. F. Hüttig and K. Kosterhorn. *Kolloid Zschr.*, **89**, *pp.* 212–214, *Nov.*, 1939. *In German.*—A gel of $TiO_2.xH_2O$ was heated between 750° and 1 000°C. and afterwards cooled in the presence of air or of HCl gas and the properties of the preparations were determined. The investigation refers especially to the loss due to burning, to X-ray pictures, to solubility, hygroscopicity, the heaped volume and the densities, these being determined by pyknometer. A distinction is made between those changes brought about by the regrouping of the surface molecules during a first preheating period reaching about 820° and those caused by the general rearrangement of the anatase lattice into that of rutile observed in the second preheating interval between 850° and 920°. The presence of HCl accelerates the formation and increases the life of the activated states. A tidal effect is observed. R. N.

919. Alumina floc. H. B. WEISER, W. O. MILLIGAN AND W. R. PURCELL. *Industr. Engng Chem.*, **32,** *pp.* 1487–1490, *Nov.*, 1940.—Alumina floc consists of a hydrous mass of minute crystals of γ-$Al_2O_3.H_2O$ (γ-$AlOOH$). The size of the primary crystals increases with increasing *p*H value of the solution from which it separates. In alkaline solution the transformation of γ-$Al_2O_3.H_2O$ to α-$Al_2O_3.3H_2O$ is fairly rapid. At a given *p*H value with different precipitants the size of the primary crystals falls off in the order: $NaOH$, NH_4OH, Na_2CO_3, Na_2S. The primary crystals of γ-$Al_2O_3.H_2O$ show a progressive increase in size on standing in contact with the mother liquor for periods of 1 to 24 hrs. Under otherwise constant conditions the primary crystals of γ-$Al_2O_3.H_2O$ increase in size with decreasing concentration of $Al_2(SO_4)_3$, in accord with von Weimarn's rule and with the expected decrease in adsorption of sulphate ion as the concentration decreases. By suitable changes in the *p*H value, time of ageing and concentration of $Al_2(SO_4)_3$, the floc of γ-$Al_2O_3.H_2O$ can be varied from primary crystals so small that the X-radiogram consists of 2 or 3 broad bands to primary crystals large enough to give well-defined lines. The use of $Al_2(SO_4)_3$ and Na_2CO_3 at a *p*H value between 5·5 and 6·5 in the precipitation of the aluminum floc is favourable for the formation of the most highly dispersed crystals of γ-$Al_2O_3.H_2O$. AUTHORS.

920. Structure of cellulose fibres. H. RUSKA. *Kolloid Zschr.*, **92,** *pp.* 276–285, *Sept.*, 1940. *In German.*—A large number of electron microscope photographs is given showing sections of cotton and artificial cellulose fibres. A compact outer bark layer and a looser marrow part may be discerned, the latter being pierced by cavities with convex boundaries. Their structure seems to be determined by the liquids enclosed. The cavities do not run exactly parallel to the fibres but appear to be formed by more or less spherical spaces interconnected by anastomosis. Inhomogeneities of micellae size may be found near the denser parts of the fibre, but structural units corresponding to micellae were found neither in cross-sections nor in longitudinal sections of the transparent parts of the marrow. R. N.

921. Double refraction and double deflection of herapathite suspensions in a flow chamber. H. H. PFEIFFER. *Kolloid Zschr.*, **92,** *pp.* 182–188, *Aug.*, 1940. *In German.*—According to tests made with herapathite suspensions in a Diesselhorst-Freundlich flow chamber [Abstr. 671 (1916)] the double refraction increases with increasing flow gradient until a point of saturation is reached. This behaviour and a kind of remanence point to a rather high viscosity of the suspension. The double refraction increases also with the thickness of the layer and partly with concentration. Preliminary treatment, ageing, colouring and mechanical influences, play some part also. The disc-shaped particles arrange themselves parallel to the broad side of the chamber and may therefore be used as a polarization foil of a distinct and variable polarizing power. The double deflection also increases with the flow gradient. The polarization factor was measured with a modified Savart polariscope. It is dependent on the aggregation of the particles, on their symmetry, on the refraction and absorption coefficient of the particles and the dispersion medium, on concentration and state of hydration of the suspension and on the wavelength of the transmitted light. R. N.

See also Abstracts 907, 949, 971.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

922. Stability of crystal lattices. VI. Properties of matter under high pressure and lattice theory of crystals. R. FÜRTH. *Proc. Camb. Phil. Soc.*, **37,** *pp.* 177–185, *April*, 1941.—[See Abstr. 304 (1941)]. The author compares results on the compression of solids, given by Bridgman [*Proc. Amer. Acad. Arts Sci.*, **74** (1940) 21], with values calculated from the lattice theory [Abstr. 4095 (1939)]. Three methods of checking are used, relating to In, S, Te, Sb and Bi, as well as to various simple ionic salts of the NaCl type. The agreement is good as far as the order of magnitude is concerned. G. G.

923. Migration of atoms in Fe-Ni alloys. E. A. OWEN AND A. H. SULLY. *Phil. Mag.*, **31,** *pp.* 314–338, *April*, 1941.—The lattice parameters of Fe-Ni alloys, quenched from temperatures between 500° and 800°, are independent of the temperature of annealing, but the quenching must be rapid and efficient if results are to be uniform. For alloys of composition ranging from pure Ni to 27 atom. % Ni, quenched as above, the lattice expands almost linearly with addition of Fe. The parameter reaches a max. for 38·6 atom. % Ni. Difficulties formerly encountered in the investigation of the 2-phase region are due to unsuitability of heat treatment and the use of unsuitable investigating radiation. In this region curves between composition and parameter are of different shapes for both the α- and the γ-components, according to the heat treatment to which the alloys have been subjected. It is possible to vary the heat treatment so as to cause migration of Ni atoms from the α- to the γ-structure, and vice versa. A. J. M.

924. Measurement of particle size by the X-ray method. A. TAYLOR. *Phil. Mag.*, **31,** *pp.* 339–347, *April*, 1941.—It is shown that a simple relationship exists between the Jones method of determining line broadening and the Warren definition. A value for the half-peak width, intermediate between that of Scherrer and that of Warren, is found to be sufficiently accurate in practice; the elaborate calculation required for the Jones method is thereby eliminated. It is also shown that the effects arising from the sudden onset of growth in a small fraction of the crystallites in a specimen cannot be correctly interpreted unless the camera radius is big enough to permit of discrimination between the original broadening (now much less marked) and the sharp lines resulting from the larger crystallites. J. T.

925. Laminarly dispersed hydroxydes and basic salts of divalent metals. W. FEITKNECHT. *Kolloid Zschr.*, **92,** *pp.* 257–276, *Sept.*, *and* **93,** *pp.* 66–86, *Oct.*, 1940. *In German.*—The secondary structures of the primary particles of hydroxydes and basic salts of Mg, Zn, Cd, Ni and Co are examined by X-ray spectrography. The form, size and other properties of the lattice structures are thus determined. The materials show partly a single-layer lattice structure, partly double-layer structures, with or without shifting of the layers as described by Arnfelt [Abstr. 4064 (1932)], roughening of the lattice or similar irregularities and instabilities. The latter is due to the comparatively high speed of germ formation at high saturations. The methods of investigation are discussed and a Bibliography of 83 articles is given. R. N.

926. Crystal structure of diphenylselenium dibromide. J. D. MCCULLOUGH AND G. HAMBURGER. *J. Amer. Chem. Soc.*, **63,** *pp.* 803–807, *March*, 1941.—An X-ray investigation of orthorhombic crystals of diphenylselenium dibromide shows a unit cell containing 4 molecules with $a_0=13{\cdot}95$ Å, $b_0=5{\cdot}78$ Å and $c_0=15{\cdot}40$ Å, all $\pm 0{\cdot}03$ Å. The space group is found to be D^{14}_{2h} *Pbcn.* With the aid of Patterson and Fourier projections on (010) and (100) the complete structure is determined. The molecule is found to have a structure approximating very closely a trigonal bipyramid with selenium at the centre, bromine atoms at the apices and the 3 equatorial positions occupied by the 2 two phenyl groups and the unshared pair. The molecular symmetry is that of C_2-2, a possible mirror plane being eliminated by rotation of the phenyl groups about the axes of the Se-C bonds. AUTHORS.

927. Diffuse reflection of X-rays. G. D. PRESTON. *Nature, Lond.*, **147,** *pp.* 467–471, *April* 19, 1941.—Gives a short historical summary of the subject and summarizes the views of the leading workers. The reflections increase in intensity with temperature and disappear at the temperature of liquid air. They may be ascribed to the presence of elastic waves in the crystal, but the exact mechanism by which they are produced is not yet fully understood. It is felt that an improved theory of the effect of thermal vibrations should provide an adequate explanation; and it is pointed out that, just as the Laue spots, or the Bragg reflections, determine the geometry of the lattice, so the background pattern gives a complete image of the main features of the dynamics of the lattice. J. T.

928. Calibration of Debye-Scherrer X-ray powder cameras. A. J. C. WILSON AND H. LIPSON. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 245–250, *May*, 1941.—Quartz has been widely used as a standard for the calibration of Debye-Scherrer X-ray powder cameras, and hence for the measurement of crystal lattice constants in terms of Siegbahn's wavelength scale. The quartz standard was first proposed by Bradley and Jay, who assumed the spacing derived from Bergqvist's measurements and determined the axial ratio, and hence *c*, by means of the camera designed by Bradley. A later direct determination of *c* by Elg, however, is not consistent with the value of *c* as derived above. The present author describes a determination of both *a* and *c* using Debye-Scherrer cameras. The results agree very closely with the value of *c* obtained by Elg and the axial ratio of Bradley and Jay, but indicate that Bergqvist's value of *a* is low by about 1 part in 20 000. AUTHORS.

DIFFUSION AND OSMOSIS.

929. Theory of diffusion in liquids. A. E. STEARN, E. M. IRISH AND H. EYRING. *J. Phys. Chem.*, **44,** *pp.* 981–995, *Nov.*, 1940.—In contrast to the Stokes-Einstein law of diffusion of large molecules through a solvent composed of smaller molecules, a detailed mathematical theory is developed for cases when solute and solvent molecules are nearly the same size, and results are shown to agree satisfactorily with experiment in the case of the diffusion of tetrabromoethane in tetrachloroethane, the aqueous diffusion of a variety of solutes, and a representative range of non-aqueous diffusions. Finally, the effect of concentration is provisionally examined. N. M. B.

930. **Absolute rates of solid reactions: diffusion.** A. E. Stearn and H. Eyring. *J. Phys. Chem.* **44,** *pp.* 955–980, *Nov.*, 1940.—Various forms of the diffusion equation obtainable from abs. reaction-rate theory are considered, and an expression is derived for the diffusion coefficient in terms of the partition function and thermodynamic quantities. This equation is examined in detail as regards its applicability to the behaviour of metals as given by extensive tabulated diffusion data, and necessary corrections are deduced. The mechanism of diffusion or nature of the activated complex and the effect of external pressure on the diffusion rate are discussed. A treatment on similar lines is given for the diffusion of gases in metals and for electrolytic conduction. N. M. B.

931. **Diffusion of water vapour through a slit in an impermeable membrane.** J. D. Babbitt. *Canad. J. Res. A.*, **19,** *pp.* 42–55, *March*, 1941.—Starting with the elementary equation for the diffusion of a vapour, an equation is developed giving the relation between the amount of vapour diffusing through a slit in an impermeable membrane and the width of the slit. The results given by this equation are compared with experimental values and a satisfactory agreement is obtained. Author.

932. **Runge pictures and Liesegang rings on filter paper.** E. Deiss. *Kolloid Zschr.*, **89,** *pp.* 146–161, *Nov.*, 1939. *In German.*—A comparison is given of the conditions leading to the formation of Runge pictures and of Liesegang rings. While the former are characterized by irregular displacement and precipitation figures caused by capillary pressure acting on a salt solution dropped on to the paper, the latter are distinguished by regular concentric rings due, not to the outer rhythm of the falling drops, but to an inner rhythm caused by diffusion. While quite a number of substances are inclined to generate Runge pictures the Liesegang rings could only be obtained by preparing the filter paper with a solution of K_2CrO_4 and, after drying, dropping on to the paper a solution of a Mn salt, with or without adding K_2SO_4. The relative humidity of the ambient air plays an important part and has to be kept below 50%. When the K was replaced by Na no rhythmic separation took place. R. N.

933. **Viscosimetric and osmometric measurements on nitrocellulose.** K. H. Meyer and E. Wolff. *Kolloid Zschr.*, **89,** *pp.* 194–201, *Nov.*, 1939. *In German.*—The measurements show that an empirical formula, given by Fikentscher for the viscosity as a function of concentration for various polymers in certain solvents, is valid for nitrocellulose in acetone. The autoviscosity is thus suitable for characterizing a nitrocellulose. A quantitative relation is given between autoviscosity and limiting or intrinsic viscosity. Depending on the uniformity of the cellulose the ratio of limiting viscosity to average mol. wt. varies between $6{\cdot}2\times10^{-4}$ and $11{\cdot}8\times10^{-4}$. [See Abstr. 1893 (1937).] R. N.

ELASTICITY AND PLASTICITY.

934. **Method of integral algebraical functions in theory of elasticity of 3 dimensions.** S. A. Savin. *J. Math. Phys.*, **20,** *pp.* 1–17, *Jan.*, 1941.

935. **St. Venant's conditions of compatibility in the method of integral algebraical functions.** S. A. Savin. *J. Math. Phys.*, **20,** *pp.* 18–22, *Jan.*, 1941.

936. **Solutions of equations of internal equilibrium of theory of elasticity.** S. A. Savin. *J. Math. Phys.*, **20,** *pp.* 23–29, *Jan.*, 1941.

937. **Plastic theory—its application to design.** J. F. Baker and J. W. Roderick. *Trans. N.-E. Cst Instn Engrs Shipb.*, **57,** *pp.* 1–28, 1940-1941.—The design of steel frame structures has always been according to the well-known working-stress method in which it is tacitly assumed that the structure will become unsafe as soon as the stress at any point within it attains the yield value of the material. This is justified for a pin-pointed structure, since collapse takes place comparatively soon after yielding commences, but if the connections are rigid, the first signs of yield do not indicate imminent collapse of the structure; collapse is, in fact, considerably delayed. With the view of producing eventually more rational methods of design for steel frame structures with fixed connections, model beams and frames have been tested to determine their true strength. Thus it has been possible to show that a beam, restrained at its ends, is able to carry more load before collapse takes place than is so in the simply supported condition. Moreover, with this restraint, the load for collapse will generally be considerably greater than that required to produce the first signs of yield. Hence, if design is based upon collapse load rather than on the first signs of yield, as is conventional, a marked economy in material should result. Authors.

938. **Displacements determined by Airy's stress function.** H. M. Westergaard. *J. Appl. Mech.*, **8,** *A*1–*A*2, *March*, 1941.—Airy's stress function defines a plane state of stress by simple formulae. When the constants of elasticity are known, Airy's function will also define the strains and detrusions by simple formulae, but the determination of the displacements is less direct. The solution described in this paper may be interpreted as a variant of a solution given by Love. Simple formulae are obtained by use of functions of a complex variable. Author.

939. Viscous and plastic flow. N. A. de Bruyne. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 251–257, *May*, 1941.—On the assumption of the existence of a modulus of elasticity independent of temperature, of a relaxation time varying exponentially with temperature, and of an interaction between elastic strain energy and activation energy, a generalized expression is derived for the relation between velocity gradient and shearing stress. It is shown that this equation is capable of representing the main types of viscous and plastic flow. AUTHOR.

940. Hysteresis in crystallization of stretched vulcanized rubber, from X-ray data. G. L. Clark, M. Kabler, E. Blaker and J. M. Ball. *Industr. Engng Chem.*, **32**, *pp.* 1474–1477, *Nov.*, 1940.—X-ray diffraction patterns are made, under carefully controlled conditions, of tensile strips of vulcanized rubber of known composition and cure, at intervals of 25% elongation up to 500%, during elongation and at the same intervals during retraction. The fibre diffraction patterns are quantitatively measured for intensity with a densitometer; these values plotted against elongation give highly characteristic hysteresis loops which are sensitive indications of the composition and previous history of the sample. These loops are determined for the initial extension of the original sample and for the fourth cycle of elongation and retraction. Correlation is established between the X-ray loops, the stress/strain diagrams and the impact resilience, as a means of giving a fundamental molecular explanation of the physical and mechanical properties. The presence or absence of 0·25% of a vulcanizing agent or an accelerator has a profound influence upon these parallel effects. Other things being equal, the greater the tendency to form ordered or crystallized regions under a given deformation and the less pronounced the hysteresis upon retraction, the greater is the resilience. Where the resilience is low, the energy developed during flexing or other deformation is expended in heat, which is dissipated to other regions of the rubber sample. AUTHORS.

941. Influence surfaces for stresses in slabs. F. M. Baron. *J. Appl. Mech.*, **8**, *A*3–*A*13, *March*, 1941.—The investigation deals primarily with the determination of influence diagrams for stresses in homogeneous elastic slabs and is based upon the extension of Müller-Breslau's principle. The analysis is based upon Lagrange's equation of the deflected middle surface of the slab. Systematic use of a stress function is made in forming the expressions for bending moments, twisting moments, and shears at any point of a semi-infinite slab cantilevered from a single fixed edge. The infinitely long rectangular slab and a circular slab with a fixed edge are considered. AUTHOR.

942. Extension of the photo-elastic method of stress measurement to plates in transverse bending. J. N. Goodier and G. H. Lee. *J. Appl. Mech.*, **8**, *A*27–*A*29, *March*, 1941.—The well-known photo-elastic method for models in plane stress is extended to plates bent transversely by cementing together 2 similar plates with a thin layer of reflecting material between them. The light thus traverses twice ½ of the full plate thickness, in which the stress is, in the simplest case, all of one sign, so that a net optical effect is obtained. Measurements on a strip of celluloid in pure bending and with circular holes yield results in conformity with theory; but a bakelite model with circular holes showed discrepancies indicating that the cement bond between the bakelite and the reflecting layer (Al foil) was not adequate. Results of measurements on semicircular notches in a strip under pure bending are also given. The difficulties and potentialities of the method are discussed. AUTHORS.

943. Theory of clay consolidation accounting for secondary compression. D. W. Taylor and W. Merchant. *J. Math. Phys.*, **19**, *pp.* 167–185, *July*, 1940.—Terzaghi's theory of soil compression is compared with the results of laboratory experiments carried out on samples. Theoretical and experimental curves are of like shape in early stages but show pronounced disagreement in later stages, because the experimental curve does not reach a horizontal asymptote within any practical testing time. The theoretical equation can be adjusted, however, and the behaviour of a building site under the load of the building can thus, in a measure, be predicted. Whilst there may be a large error in the result, it proves a better guide in practice than the pure guess which is hitherto the only available procedure. W. A. R.

944. Thermal studies on asbestos. Effect of heat on the breaking strength of asbestos cloth containing cotton. D. Wolochow. *Canad. J. Res. B*, **19**, *pp.* 65–67, *March*, 1941.—Commercial, Underwriters', and A grades of asbestos cloth begin to lose strength as soon as heat is applied. On heating for 5 min. at 300°C. these 3 grades of asbestos cloth lose approximately 60%, 35% and 25% of their original (conditioned) breaking strength, respectively. Charts are given showing the effect of heating, at temperatures up to 600°C., for periods up to 1 hr. AUTHOR.

HYDRODYNAMICS AND AERODYNAMICS.

945. Liquid jets of annular cross-section. A. M. Binnie and H. B. Squire. *Engineer, Lond.*, **171,** *pp.* 236–238, *April* 11, 1941.—When a low-velocity jet issues from an annular orifice, surface tension causes the jet to coalesce after a short distance and then to continue with a solid cross-section. At great velocities this kind of jet disintegrates. An approximate theory of the form of the annular portion is derived and compared with experiments made with a specially constructed apparatus. The length of the annular portion was found to be very sensitive to internal pressure. The analysis is not valid up to the point of coalescence. W. A. R.

946. Flow of a viscous fluid past a flat plate using elliptic co-ordinates. T. V. Davies. *Phil. Mag.*, **31,** *pp.* 283–313, *April*, 1941.—The motion of a viscous liquid past a flat plate of infinite length along the z-axis, of finite breadth in the plane $y=0$ and of vanishingly small width in the direction of the y-axis, the motion of the liquid being the same in all planes parallel to $z=0$ and parallel to the x-axis at infinity, has been investigated. The stream function for the motion is obtained, and an expression for the drag on the plate is deduced. The analytical work is based on the theory of the Mathieu and associated Mathieu functions, and a number of Appendices are concerned with the latter. A. J. M.

947. Artificial drainage of land: stream-line experiments. The artesian basin. I–II. D. Kirkham. *Trans. Amer. Geophys. Un.*, *pp.* 677–680, 1939, *and pp.* 587–593, 1940.—Experiments showing the upward stream-line flow of water under artesian pressure into land drains are described. The flow-pattern shows that all the underground water enters the drains, and that none penetrates to the surface, although the artesian pressure would eject water from an open well. Part II gives an analytical theory of stream flow under artesian pressure which agrees quantitatively with experiments in sand tanks. The spacing of tile drains required to drain water-logged artesian land would, in most cases, be prohibitive in cost. W. A. R.

948. Discharge by surface floats. W. M. Griffith. *J. Instn Civ. Engrs*, **15,** *pp.* 284–296, *Feb.*, 1941.—In the rivers of the Great Ouse Catchment Board the discharge is not a stable function of the water level. The usual method of computing daily discharge by means of a stage-discharge curve was not applicable, so a special method was devised, consisting in obtaining daily, at carefully selected sites, the max. surface velocity of flow by timing a float and the water level by reading a gauge: the discharge is computed from these observations by means of a table. It is assumed that the ratio of max. surface velocity to mean velocity is a stable function of the gauge reading. The theory of the method is given and the paper is illustrated by tables. W. A. R.

949. Importance and meaning of the theory of flow. S. Erk. *Kolloid Zschr.*, **89,** *pp.* 208–211, *Nov.*, 1939. *In German.*—Starting from graphs showing the dependence of the speed of flow and of viscosity on the pressure or shearing gradient, the author defines the scope of the theory of flow and discusses applications in colloid physics, thermodynamics, lubrication, etc. R. N.

950. Orifice nomograph. D. S. Davis. *Industr. Engng Chem.*, **33,** *pp.* 420, *March*, 1941.

KINETIC THEORY OF MATTER.

951. Interactions of gases with metals and crystalline solids. J. K. Roberts. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7,** *pp.* 303–328, 1941.

952. Recombination of I and Br atoms. O. K. Rice. *J. Chem. Phys.*, **9,** *pp.* 258–261, *March*, 1941.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

953. Mechanical method for graphical solution of polynomials. S. L. Brown and L. L. Wheeler. *J. Franklin Inst.*, **231,** *pp.* 223–243, *March*, 1941.—A mechanical synthesizer with 30 harmonic elements (15 sin components and 15 cos components) may be used to graph a polynomial in a complex plane. The sum of the sin components is recorded by a tracing point which moves vertically. The sum of the cos components is recorded by horizontal motion of a drawing board. Expansion of the polynomial by De Moivre's theorem expresses the function as a sum of sin terms and a sum of cos terms. The polynomial may then be graphed by the machine and thereby the complex roots determined. A number of typical curves are given to illustrate the machine method of determining real, imaginary and complex roots. An auxiliary method is described which gives all the real roots of the polynomial from a single graph. Authors.

954. The indeterminate families of series of natural numbers and problems concerning the property C. F. Rothberger. *Proc. Camb. Phil. Soc.*, **37,** *pp.* 109–126, *April*, 1941.

955. Quadratures involving trigonometric sums. R. H. Cameron. *J. Math. Phys.*, **19,** *pp.* 161–166, *July*, 1940.

956. Theorem on maxima and minima with an application to differential equations. L. M. Court. *J. Math. Phys.*, **20**, *pp.* 99–106, *Jan.*, 1941.

957. The Gauss-Codazzi-Ricci equations in Riemannian manifolds. A. Schwartz. *J. Math. Phys.*, **20**, *pp.* 30–79, *Jan.*, 1941.

958. General type of Lie's differential equations. M. O. González. *J. Math. Phys.*, **20**, *pp.* 80–88, *Jan.*, 1941.

959. Integral inequality of the Phragmen Lindelof type. N. Levinson. *J. Math. Phys.*, **20**, *pp.* 89–98, *Jan.*, 1941.

960. A theorem of Rengels. D. C. Spencer. *J. Math. Phys.*, **20**, *pp.* 118–123, *Jan.*, 1941.

961. Distortion in analytical transformations. D. C. Spencer. *J. Math. Phys.*, **20**, *pp.* 124–126, *Jan.*, 1941.

962. Hardy's theorem on the zeros of the zeta function. N. Levinson. *J. Math. Phys.*, **19**, *pp.* 159–160, *July*, 1940.

963. Visualization of domains of the theory of functions of two complex variables. S. Bergman. *J. Math. Phys.*, **20**, *pp.* 107–117, *Jan.*, 1941.

964. Colouring the nodes of a network. R. L. Brooks. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 194–197, *April*, 1941.

965. Sets of fractional dimensions. E. Best. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 127–133, *April*, 1941.

See also Abstracts 946, 950, 1044, 1045.

MECHANICS, CLASSICAL.

966. Action in a uniform field. L. A. Pars. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 168–176, *April*, 1941.—For the motion of a particle in a plane field of force the action integral is stationary for an orbit joining 2 given points. The author discusses the question whether the integral is a min. and, if so, whether it is relative or absolute. The conditions are found, with respect to the Goldschmidt curve, for which the integral may be either a relative or an absolute min. The explicit formula for the action is derived, and certain properties of the action, important in dynamics, are pointed out. G. E. A.

MECHANICS, QUANTUM.

967. Some points of the Bose-Einstein condensation. L. Goldstein. *J. Chem. Phys.*, **9**, *pp.* 273–279, *March*, 1941.—The peculiar condensation in phase space of ideal Bose-Einstein gases is discussed when the internal energy states of the atoms or molecules is taken into account and when the gas of atoms without internal structure is placed in an external conservative field of force. The inclusion of the internal energy states decreases, while the application of the external field increases, the condensation temperature from its value in absence of either of these causes. The transition phenomenon, apart from the preceding change in the condensation temperature, proceeds in the same way as in the case of the free gas atoms without internal structure; in particular, the order of the transition remains invariable, as the continuity of the heat capacity at constant volume is maintained at the transition point. Author.

PRESSURE.

968. Factors influencing the performance of diaphragm indicators of explosion pressures. F. R. Caldwell and E. F. Fiock. *Bur. Stand. J. Res. Wash.*, **26**, *pp.* 175–196, *March*, 1941.—Information obtained during the development and use of accurate diaphragm-type indicators of the pressures developed during explosions of gaseous mixtures in bombs is presented. Although some of the following conclusions are not original, all are supported by new experimental evidence. It is shown that all passages and cavities on the explosion side of the diaphragm should be eliminated for highest accuracy. Although the sensitivity of the diaphragm to pressure difference must not be less than the value determined by the accuracy with which pressures are to be measured, it is important, when highest accuracy is desired, that the sensitivity shall not greatly exceed this same value so that the inertia error will not become larger than the allowable tolerance. Radial tension in the diaphragm is advantageous in reducing time lag. A blued or polished surface is preferable to one which absorbs more radiant energy. Projections around the diaphragms are without measurable effect upon the performance of the indicators. It seems probable that, with a properly designed indicator, the measured values of explosion pressure need not deviate from the actual pressure by more than a few tenths of 1 mm. Hg. Authors.

RELATIVITY AND ETHER.

969. Cinematical relativity. E. A. Milne, A. G. Walker and G. C. McVittie. *Observatory*, **64**, *pp.* 11–25, *April*, 1941. A discussion. [Abstr. 40 (1941).]

SOLUTION.

970. Solubility effect in solvents of low dielectric constant. I. Solubility of tetrabutylammonium iodide in benzene in the presence of tetrabutylammonium picrate and nitrate. A. A. Vernon, W. F. Luder and M. Giella. *J. Amer. Chem. Soc.*, **63**, *pp.* 862–864, *March*, 1941.—The solubility is found to increase rapidly with the concentration of added salt. The nature of the problem and of the proposed research are discussed. AUTHORS.

SURFACE PROPERTIES.

971. Hysteresis in sorption. I–VI. K. S. RAO. *J. Phys. Chem.*, **45**, *pp.* 500–539, *March*, 1941.—Hysteresis loops showing permanence and reproducibility were found in the sorption at 30° of water on titania gel and on silica gel, and of CCl_4 on silica gel, on Fe_2O_3 gel, and on activated rice grains. Scanning the loops by traversing from various points on the sorption and desorption curves shows certain characteristics forming a convincing proof of the concept of cavities with constricted ends as the general cause of hysteresis. In the sorption of water vapour at 30° Fe_2O_3 gel gives a hysteresis loop exhibiting several unique phenomena which, in the light of the cavity concept, reveal the coalescence of the colloidal particles of Fe_2O_3 gel into larger aggregates during successive sorptions and desorptions. A series of sorptions and desorptions of water vapour at 30° on activated rice and dhal grains shows a unique colloidal behaviour: the disappearance of the initial hysteresis loop; and an explanation, based on the cavity concept, is proposed. Through their property of swelling on imbibing water the grains become elastic and the cavities with elastic walls lose their property of entrapping water; hence the hysteresis effect disappears. N. M. B.

972. Polarity of surfaces determined by polymer absorption. P. A. THIESSEN AND E. BEGER. *Kolloid Zschr.*, **89**, *pp.* 175–177, *Nov.*, 1939. *In German.*—The character of a surface may be assessed by its power of adsorbing organic dyestuffs. Molecular layers of larger test surfaces than those of naturally grown crystals were used in the experiments. The formation of the Y films is explained, in which an even-numbered layer is attached to an odd-numbered layer in immediate contact with the surface. The polymer adsorption at well-defined molecular layers as previously described [Abstr. 1206 (1938)] was measured by an extinction method determining the degree of polarity of the surface. R. N.

973. Influence of salts on the adsorption of strong acids. C. W. CARR, H. FREUNDLICH AND K. SOLLNER. *J. Amer. Chem. Soc.*, **63**, *pp.* 693–696, *March*, 1941.—The change in adsorption of H (and OH) ion caused by an excess of other inorganic ions was investigated using both an activated and a non-activated charcoal. The assumption that the added salt always causes an increase in the adsorption of the H ion and that this is due to an electrical effect, a kind of swamping, was found to be unwarranted. AUTHORS.

974. Studies in peat. X. Activated charcoals from peat residue. J. REILLY AND J. R. O'DONOGHUE. *Sci. Proc. Roy. Dublin Soc.*, **22**, *pp.* 367–377, *April*, 1941.—Active charcoal has been prepared from peat residue, i.e. peat after removal of the waxy constituents, by a number of methods: activation with warm concentrated H_2SO_4; impregnation with $ZnCl_2$ and subsequent carbonization; impregnation with H_3PO_4 followed by ignition at high temperatures; activation with superheated steam. The 25 charcoals prepared have been examined for the following properties, details of which are given: percentage yield, appearance and hardness, bulk density, phenol adsorption, and decolorization of molasses solutions. Activation with superheated steam, and, to a lesser extent, treatment with syrupy H_3PO_4 before carbonization, have been found to give charcoals of performance approaching commercial standards. H. H. HO.

975. Investigation of high-boiling petroleum oils by adsorption analysis. B. C. ALLIBONE. *J. Inst. Petrol.*, **27**, *pp.* 94–108, *March*, 1941.—This paper describes the application of chromatographic adsorption to the analytical separation of the high-boiling components of petroleum. A distillation cut of restricted boiling range is dissolved in aromatic free petroleum ether, b. p. 60°–80° C., and the solution filtered through a column of adsorbent. The adsorbent may advantageously be silica gel. After the addition and exhaustion of the primary solution fresh petroleum ether is added to the top of the column and the filtration continued until the high-boiling material recovered from a unit of filtrate approaches a sp. gr. of unity. The adsorbent is then drained by suction, removed from the column and allowed to dry. The dried adsorbent is divided into suitable portions, as its variation in colour or other consideration may dictate, and extracted with a solvent or a succession of solvents. By these means, with variations to suit individual stocks, high-boiling cuts, whether distillates or residues, may be separated into a succession of components of widely varying physical characteristics. The application of the procedure and the degree of separation achieved are illustrated by means of selected examples. AUTHOR.

976. Adsorption at crystal/solution interfaces. XI. Study of the adsorption of isomeric monoazo dyes by crystals of $NaNO_3$, $NaBrO_3$ and $NaClO_3$ during their growth from solution. W. G. FRANCE AND K. M. WOLFE. *J. Phys. Chem.*, **45**, *pp.* 395–401, *March*, 1941.

977. Macleod constant and its dependence on physicochemical factors. D. T. LEWIS. *J. Phys. Chem.*, **44**, *pp.* 1007–1011, *Nov.*, 1940.—A combination of Macleod's equation for surface tension, $\gamma = C\,(D-d)$, where D and d are the densities of the liquid and saturated vapour, with the mean-density equation of Cailletet and Mathias leads, with certain justifiable simplifications and extrapolations to abs. zero, to $\gamma^{1/4}=\gamma_0^{1/4}(2T_c-T)/2T_c$, which expresses the variation of surface tension from abs. zero to the critical temperature. Observed and calculated data for $CHCl_3$ show good agreement. A combination of Macleod's equation with a modified Eötvös equation leads to an expression for γ analogous to Sugden's expression $\gamma=\gamma_0(1-T_r)^{6/5}$. Conditions of application of the various equations examined are discussed. N. M. B.

978. Physical properties of fluid interfaces of large radius of curvature. I. Integration of Laplace's equation for the equilibrium meridian of a fluid drop of axial symmetry in a gravitational field. Numerical integration and tables for sessile drops of moderately large size. II. Numerical tables for capillary depressions and meniscus volumes in moderately large tubes. III. Integration of Laplace's equation. Approximate analytical integration for sessile drops of large size. B. E. BLAISDELL. *J. Math. Phys.*, **19**, *pp.* 186–245, *July*, 1940.—The need for accurate capillary corrections in precise manometry is pointed out, and the lack of adequate methods for evaluating these corrections is discussed. Numerical methods are outlined for integrating Laplace's differential equation for the equilibrium meridian of a fluid drop of axial symmetry in a gravitational field. The numerical integrations are carried out for real values of the capillary constant *a* and for drops of moderately large size; the results are presented in tables.—Tables to 5 significant figures are given of capillary depression and meniscus volume as functions of meniscus height and tube diameter.—Approximate analytical methods are given for integrating Laplace's equation in the case of very large drops. The solution is given in 2 parts, one for the centre and the other for the edge of the drop. The formulae are shown by comparison with the exact results of numerical integration to be accurate to within 0·1% for all drops of equatorial radius greater than 5·0. AUTHOR.

979. Energy associated with capillary rise. R. C. BROWN. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 233–234, *May*, 1941.—When a liquid rises in a capillary tube, energy is required not only to raise the column against gravity but also to overcome the viscous forces. These two quantities of energy are shown to be equal. By equating their sum to the energy made available by the wetting of the walls of the tube, the usual capillary-rise equation is obtained. AUTHOR.

980. Surface tension. R. C. BROWN. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 180–194, 1941.

981. Boundary surface phenomena with silica gels. R. KÖPPEN. *Kolloid Zschr.*, **89**, *pp.* 219–223, *Nov.*, 1939. *In German.*—Some phenomena connected with the behaviour of OH ions in feebly alkaline solutions containing silica gel and treated with neutral salts lead to the assumption that the double layer bounding the gel particles is covered by OH ions. Chemi-sorption of the alkali ion takes place on the surface of the gel. The saponification catalysis is not necessarily a surface effect as H and OH ions are always present in the capillary system. A change takes place in the surface activities of the silica gel if the OH ions are replaced by the anions of strong anorganic acids. The adsorption of dyestuffs from solutions may be explained by the double layer of ions on the boundary surfaces of the gel. It is not necessary to assume a special affinity between dyestuff and gel. R. N.

982. Surface tension of aqueous perchloric acid at 15°, 25° and 50°C. C. A. NEROS AND W. G. EVERSOLE. *J. Phys. Chem.*, **45**, *pp.* 388–395, *March*, 1941.—By means of a simple device errors due to variation in the radii of the capillaries can be reduced to a min. in the differential capillary-rise method. Both a max. and a min. were observed when the surface tension of perchloric acid was plotted against the percentage composition. The initial lowering of surface tension was explained as being due to the formation of a hydrogen bond at the interface, as postulated by Ariyama. AUTHORS.

983. Films from cellulose-xanthate solutions: influence of alkali upon physical properties. E. HEUSER AND H. Y. CHARBONNIER. *Industr. Engng Chem.*, 33, *pp.* 402–403, *March*, 1941.

984. Influence of grinding treatments on the surface hardness of intaglio printing plates of 0·33% carbon steel. H. K. HERSCHMAN AND F. KNOOP. *Bur. Stand. J. Res. Wash.*, **26**, *pp.* 261–272, *March*, 1941.—A study was made of the surface-hardening effects in plates used for intaglio printing. These plates were of 0·33% carbon steels having different metallographic structures and finished under different grinding conditions. The influence of the following factors in the grinding conditions on the surface hardness of the steels was investigated: (1) cooling conditions during grinding, (2) grain size of the abrasive, (3) depth of cut, and (4) rate at which the abrasive wheel passes over the specimens. Variations in the hardness of the steels at different levels beneath the ground surfaces were determined by applying different loads on an elongated pyramidal-diamond indenter. The geometrical irregularities of the surfaces of the ground specimens, evaluated by the tracer method, were considered with respect to their influence on the accuracy of measurement of surface hardness by the indentation means employed and their relationship to surface hardness. AUTHORS.

985. Use of mineral oils as mosquito larvicides. H. D. LORD. *J. Inst. Petrol.*, **27**, *pp.* 73–88; *Disc.*, 88–93, *March*, 1941.—A brief history of researches on the use of mineral oils for anti-malarial work is given. A summary of Murray's recent investigations follows; perhaps the most important point is that spreading pressure is all-important, and that toxicity is not nearly so crucial as had been previously accepted. A description of the Adam-Langmuir apparatus for the measurement of surface pressure follows, and this is used extensively as a criterion of the quality of various anti-malarial oils. The effects of storage, exposure to diffused and bright sunlight and addition of resin, are described; also, limitations of the Adam apparatus, and the care which must be exercised in interpreting results therefrom, are illustrated, with special reference to a used naphthalene extraction oil. Essential requisites of a superior anti-malarial oil are discussed, and it is shown that a residue from pressure distillate fulfils these requirements. AUTHOR.

See also Abstracts 912, 951.

VISCOSITY AND FRICTION.

See Abstracts 905, 910, 933.

ASTRONOMY AND ASTROPHYSICS.

NEBULAE.

986. Effect of the presence of foreign atoms on the electron velocity distribution in a planetary nebula composed of hydrogen. Y. HAGIHARA. *Tokyo Astr. Bull.*, *Nos.* 485–489, *pp.* 969–978, *Oct.* 7, 1940.—The author examines how the admixture of other atoms to a planetary nebula consisting of H atoms is likely to affect the velocity distribution of the free electrons. Of the atoms abundant in nebulae, and with ionization potential nearly equal to that of H, O and N tend to make the distribution conform to Maxwell's law, whereas C increases the deviation. However, the abundances of O and N are not high enough to remove the deviation, which is very great for H alone, and will still be great in the presence of foreign atoms so long as their abundances do not greatly exceed those actually observed. A. HU.

PLANETS.

See Abstract 990.

STARS.

987. The λ6708 resonance line of LiI in the spectrum of the N-type variable star WZ Cassiopeiae. A. MCKELLAR. *Observatory*, **64**, *pp.* 4–11, *April*, 1941.—The resonance doublet of LiI appears strongly in absorption (equivalent width 8 Å) in this spectrum, which is of type N1p, though it has been observed nowhere else extra-terrestrially except (very faintly) in the solar spectrum. Other R- and N-type spectra obtained by the author show the strong *D* lines prominent in WZ Cas but not the Li doublet. It is therefore suggested that the occurrence is due to high abundance of Li in the atmosphere of this particular star, especially as in other respects, e.g. in absolute magnitude and radius, WZ Cas seems an average N-type giant. The observation is important in view of the fact that lithium nuclei in the interior of such stars should, on Gamow's theory, play an important part in generating their energy. A. HU.

988. Notes on binary stars. I–III. T. E. STERNE. *Proc. Nat. Acad. Sci., Wash.*, **27**, *pp.* 93–108, *Feb.*, 1941.—Formulae are derived for the surface gravity of a rotationally and tidally distorted fluid component of a binary star. The formulae are valid for any distribution of density, but numerical coefficients are given to facilitate the computation of the apsidal motions, distortions and surface gravities, of some polytropic models. Equations are next derived for the variation in light of a binary out of eclipse, as influenced by rotational and tidal distortions, and some systematic corrections are considered to the observed abs. magnitudes of rotating stars. Finally, the author predicts the effects on the light outside eclipse of changes of figure due to revolution in an eccentric orbit. Ordinary and gravitational darkening are allowed for, and the results apply to any density distribution. A. HU.

See also Abstract 990.

SUN.

989. Solar physics. A. D. THACKERAY. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 160–179, 1941.

990. Mount Wilson Observatory Report. *Carnegie Instn Yearb.*, *No.* 39, *pp.* 3–28, 1939–1940.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

991. Geophysical Laboratory Report. *Carnegie Instn Yearb., No.* **39,** *pp.* 29–54, 1939–1940.

METEOROLOGY.

992. Measurement of wind velocities with the Kata thermometer. J. McCombe. *Elect. Times,* **99,** *p.* 197, *March* 27, 1941.—The instrument is an alcohol thermometer and wind velocities are measured by noting the time taken to cool it through a given temperature range. A simple calculation is necessary, but the results are much more accurate than with an anemometer. The thermometer is extensively used in the ventilation of buildings where absolute humidity and vapour pressure have to be taken into account. In these circumstances it is used as a wet thermometer.

A. P. W.

993. Chart of air-vapour mixture properties at different pressures. R. C. Binder. *J. Appl. Mech.,* **8,** *A*14–*A*16, *March,* 1941.—A discussion is given of the use of a total *P*/*T* diagram provided with reversible adiabatic and specific-humidity lines for mixtures of air and water vapour. The graphical relation between dew-point temperature, dry-bulb temperature and specific humidity, is given directly for any total pressure on this chart. From this relation the vapour pressure and relative humidity can be easily calculated. Author.

994. Report on the phenological observations in the British Isles from December, 1939, to November, 1940. H. C. Gunton. *Quart. J. Roy. Met. Soc.,* (*Phenol. Rep.*), **67,** *pp.* 67–97, 1941.

995. Glaciers of Antarctica. L. M. Gould. *Proc. Amer. Phil. Soc.,* **82,** 5, *pp.* 835–876, 1940.—The marginal features of the inland ice, its various forms and the effects of mountain ramparts, are described and discussed. The glaciers are considered to be of tectonic origin. The characteristics and formation of various examples of shelf ice and the main features of mountain glaciers, cirques and cirque ice, are examined. The former thickness, area and activity, of Antarctic glaciers, and the effects of erosion and deposition, are considered. In a discussion of glacial activity and climate it is concluded that the beginning of the intense cold and decreased ice formation occurred in the early Pleistocene period, that erosion occurred in the early Tertiary, while major erosion occurred in the middle Tertiary period. R. S. R.

SEISMOLOGY.

996. Energy of local earthquakes recorded at Fordham. W. A. Lynch. *Bull. Seism. Soc. Amer.,* **30,** *pp.* 331–335, *Oct.,* 1940.—Rough calculations yielded results varying from $3{\cdot}4 \times 10^{12}$ ergs to $3{\cdot}7 \times 10^{15}$ ergs for 13 different shocks. Numerous assumptions render the values uncertain in abs. magnitude, but it is believed that they are correct in order of magnitude. Author.

997. The Alaskan earthquake of July 22, 1937. J. N. Adkins. *Bull. Seism. Soc. Amer.,* **30,** *pp.* 353–376, *Oct.,* 1940.

998. The Salvador earthquakes of December, 1936. S. B. Levin. *Bull. Seism. Soc. Amer.,* **30,** *pp.* 377–407, *Oct.,* 1940.

999. Adapting the Milne-Shaw seismograph to registration of diurnal tilts. L. D. Leet. *Bull. Seism. Soc. Amer.,* **30,** *pp.* 327–329, *Oct.,* 1940.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1000. Department of Terrestrial Magnetism Report. J. A. Fleming. *Terr. Magn. Atmos. Elect.* 46, *pp.* 43–50, *March,* 1941. *Carnegie Instn Yearb., No.* 39, *pp.* 55–112, 1939–1940.

RADIOACTIVITY.

1001. Relative efficiencies of radioactive neutron sources. E. J. Murphy, W. C. Bright, M. D. Whitaker, S. A. Korff and E. T. Clarke. *J. Franklin Inst.,* **231,** *pp.* 357–371, *April,* 1941.—A number of Ra-Be and Rn-Be neutron sources are compared. It is found that the Rn sources may vary in efficiency by more than a factor of 2, while the Ra sources seldom vary by more than 15%. These efficiencies are based on the customary assumed ratio of γ-ray activity to neutron production. Sources manufactured under similar conditions are found to compare more favourably, i.e. with less variation among themselves. The reasons for the variations are investigated as well as the factors influencing the efficiency. It is found that, for the Ra sources, the mixing and the size of the Ra grains and the purity of the Be are important. For the Rn sources it is important that the container be as full as possible, with as little space as possible occupied by gas alone.

The contribution of photo-neutrons to the total emission is investigated and found to be of the order of 0·02. Authors.

1002. Deposition of atmospheric radioactivity on objects exposed to air streams. S. Freed and M. L. Schultz. *J. Franklin Inst.*, **231,** *pp.* 345–355, *April*, 1941.—When air was blown against various objects, radioactive material was deposited which was identified as the decay products of radon and thoron. The deposition took place on glass, mica, and on the metals: copper, brass, steel, aluminium, but not on lead. It was immaterial whether the metals were earthed or insulated. No appreciable electrical potential was produced on the objects by the streaming gas. A deflecting electric field in an ion collector which was inserted in the air-line did not diminish the rate at which the deposit formed. After snowfall or rainfall the air furnished but a small fraction of the radioactivity observed at other times. Oxygen gas from cylinders, but not N, H or CO_2, produced deposits on the various objects. After N had been directed against Al for 45 min., air failed to deposit its radioactive content on the Al surface despite a steady stream lasting for almost 1 hr. Several hours later, however, the deposition became normal. A large discrepancy was found in the intensity of the deposit from 2 samples of O which had been compressed into cylinders the same day but tested at different times. The older O was much more effective than was anticipated on the bases of the half-life of radon and of the data on radioactive impurities in steel (cylinders). It is inferred that smoke, dust, etc., blown about in the atmosphere, gathers radioactive and hence ionizing substances by the process responsible for the phenomena described. Authors.

1003. Gamma radiations emitted in nuclear processes. N. Feather. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7,** *pp.* 66–86, 1941.

1004. Use of the radioactive properties of thorium for a quantitative study of phagocytosis. F. A. Maxfield and O. A. Mortensen. *J. Appl. Phys.*, **12,** *pp.* 197–202, *March*, 1941.

See also Abstract 1077.

RADIATION.

ABSORPTION.

1005. Absorption of light in interstellar space. A. Hunter. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7,** *pp.* 150–159, 1941.

COLORIMETRY.

1006. Ferric chloride as a permanent standard in the colorimetric estimation of nitrate. G. V. L. N. Murty. *Proc. Indian Acad. Sci. A*, **13,** *pp.* 116–118, *Feb.*, 1941.

1007. Colour, its measurement, discrimination and specification. J. W. Perry. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 272–287, *May*, 1941.—Colour tolerances are considered under 3 main headings: liminal, on basis of R.U.C.S.; technical, in terms of phenomena possibly involved; and economic. Tolerances for subtractive colour mixtures are analysed for practical application. A uniform-chromaticity scale of saturation is proposed. Author.

1008. Technical aspect of colour tolerance. H. W. Ellis. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 288–292, *May*, 1941.—The author discusses the extent to which the characteristics of dyed materials are governed by the technical limitations of dyestuffs and the various factors which have to be considered in the selection of dyes to produce a given result. The terms shade and strength as employed by the dyestuff-using industries are defined, and the methods are described by means of which these two factors are measured and controlled in the commercial production of dyed materials. Author.

EMISSION.

1009. Production of mesotrons by penetrating non-ionizing rays. B. Rossi and V. H. Regener. *Phys. Rev.*, **58,** *pp.* 837–838, *Nov.* 1, 1940.—In experiments carried out at 4 300 m. above sea level, using 4 counters surrounded by 7 others in parallel, with absorbers of Pb in various positions, it is claimed that the results show that non-ionizing rays produced ionizing rays, namely mesotrons, in the absorbers. The experiments also throw some light on the nature of the mesotron-producing rays. It is concluded that the non-ionizing rays which produce mesotrons are more penetrating than photons; they could be neutral mesotrons or high-energy neutrons; the latter is the more likely. G. O. B.

FLUORESCENCE AND PHOSPHORESCENCE.

LUMINESCENCE AND AFTERGLOW.

1010. Fluorescence of some purines and pyrimidines. M. M. Stimson and M. A. Reuter. *J. Amer. Chem. Soc.*, **63,** *pp.* 697–699, *March*, 1941.—It is found that in general the purines and pyrimidines investigated are more highly fluorescent in basic than in acid solution. Applications are suggested for use in ultra-chromatograms and in checking the purity of these compounds. An inexpensive and rapid method is described for viewing fluorescent materials in solution and in chromatograms. AUTHORS.

1011. Technology of brightness production by near-ultra-violet radiation. J. O. KRAEHENBUEHL AND H. J. CHANON. *Illum. Engng, N.Y.*, **36,** *pp.* 151–168, *Feb.*, 1941.—Luminescence under near-ultra-violet radiation is now an important matter to the illuminating engineer. This paper deals with suitable sources of radiation and their measurement by means of the luminescence produced in uranium glass. The luminescent response of a number of commercial materials is tabulated and the response is stated in terms of the "fluorfactor." This factor is the brightness of the material when irradiated by one unit of flux of near-ultra-violet radiation per sq. ft. of material. A system of units and nomenclature is suggested. In this system the unit of flux is 1 mW of near-ultra-violet radiation. J. W. T. W.

INTERFERENCE, DIFFRACTION AND SCATTERING.

1012. Determination of $1/\lambda_2-1/\lambda_1$ for the D_1, D_2 lines of sodium. G. F. C. SEARLE. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 265–271, *May*, 1941.—Using a sodium lamp, Newton's rings are formed between one surface of a plane parallel plate and the convex surface of a lens and are observed in the usual manner. The incident rays are normal to the plate. The distance between the plate and the lens is varied and is measured by the screw of a spherometer. By suitable adjustment of the distance the bright rings due to D_1-light may be made to coincide, near the centre of the ring system, either with the bright rings due to D_2-light or with the dark spaces between those rings. In the first case a strong ring pattern is seen. In the second case the pattern is very weak; it is still visible, because the intensity of the D_2-light is about twice that of the D_1-light. If t be the width of the gap in either of the two cases, $1/\lambda_2-1/\lambda_1=\frac{1}{4}q/t$, where q is zero or an even integer for a pattern of max. strength and an odd integer for one of min. strength. The phenomena may be traced up to $q=20$ or further. AUTHOR.

1013. Optically reciprocal gratings and their application to syntheses of Fourier series. M. J. BUERGER. *Proc. Nat. Acad. Sci., Wash.*, **27,** *pp.* 117–124, *Feb.*, 1941.—A mathematical discussion of gratings and their diffraction from a reciprocal-lattice point of view. A. H.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1014. Acceleration of development. LÜPPO-CRAMER. *Kolloid Zschr.*, **92,** *pp.* 221–225, *Aug.*, 1940. *In German.*—Although appearing rather different at first sight a number of reactions connected with photographic development, especially with acceleration, may be explained by a common principle of colloid chemistry. The accelerating action is due to an increase in the dispersity of the silver germs. This is brought about by adsorptions to the silver bromide or by interspersion of the oxydation products of certain developers or in some cases by enveloping compounds of heavy metals. R. N.

1015. Shape of stereoscopic images. J. T. RULE. *J. Opt. Soc. Amer.*, **31,** *pp.* 124–129, *Feb.*, 1941.—In order to provide means for the analysis of stereoscopic effects, determine the reasons for observed distortions and predict the results of particular optical systems, formulae are derived for locating image points and a graphical method is developed for projecting any object plan directly into the resultant image plan when the conditions of photographing and projecting are given. It is possible to utilize a single projection plane and centre of projection and obtain on the projection plane the stereo-image plan directly from the object plan. A. W.

PHOTOMETRY.

***1016. Construction and test of a goniophotometer.** P. MOON AND J. LAURENCE. *J. Opt. Soc. Amer.*, **31,** *pp.* 130–139, *Feb.*, 1941.—A photoelectric goniophotometer is described and methods of operation are discussed. The instrument will give abs. measurements of reflection factor for either specular or matt samples, and with polished materials exhibiting both specular and diffuse reflection the 2 components are easily separated. Test results are given for comparison with the Fresnel formula for a polished black glass sample illuminated with ordinary and also with polarized light. Other results are given for samples of woollen cloth at various angles of incidence and various angles of view. Data are also given for the separation of the specular and diffuse reflection factors for a sample of polished white opal glass. A. W.

***1017. Foot-candle-hour integrator for daylight.** A. H. TAYLOR. *J. Opt. Soc. Amer.*, **31,** *pp.* 105–106, *Feb.*, 1941.—Examination of curves for the spectral-energy distribution of daylight, plotted on a basis of equal illumination, shows that, if practically monochromatic energy in a band centred at λ5 600 is measured, the result will be proportional to the illumination to within a few

p.c. The same is true for tungsten-filament lamps. A suitable filter isolates the narrow frequency band required and the transmitted light acts on a Cs photo-electric tube. The current from the latter is used to charge a condenser, which is partially discharged through a small neon lamp when its voltage reaches about 75 V. The sudden flash of the neon lamp changes the grid voltage of a valve and produces a large drop in anode current, with recovery shortly after. This effect is used to record the impulse and hence to obtain an integration of the light. Calibration is effected by comparison with photometric measurements over a period of several hours.
A. W.

***1018. Voltage stabilization equipment.** E. R. Sabato. *Publ. Fac. Cienc. Fis.-Mat., La Plata, No.* 139, *pp.* 425–432, 1940. *In Spanish.* [Abstr. 709 B (1941).]

See also Abstract 1023.

POLARIZATION.

See Abstract 921.

REFLECTION, REFRACTION AND DISPERSION.

1019. Synthetic optical crystals. H. C. Kremers. *Industr. Engng Chem.*, **32**, *pp.* 1478–1483, *Nov.*, 1940.—Advances in ultra-violet and infra-red spectroscopy have brought about the need for more and larger optical crystals than are found in nature. LiF crystals up to 8 lb. in weight, NaCl crystals up to 25 lb. and superior to natural rocksalt, are grown. KBr and KI crystals for far-infra-red transmission are also grown. Natural calcite of optical quality is scarce, and the increasing demand for polarizing optics has stimulated the synthetic production of large single crystals of $NaNO_3$.
Author.

1020. Paints to reflect ultra-violet light. D. F. Wilcock and W. Soller. *Industr. Engng Chem.*, 32, *pp.* 1446–1451, *Nov.*, 1940.—The stages of development of paints reflecting up to 70% in the ultra-violet are (*a*) testing of reflection or transmission of possible paint materials, (*b*) testing of the simplest possible combinations of pigment and vehicle to determine those suitable, (*c*) determination of those resin-plasticizer combinations which form good films and have low ultra-violet absorption, and (*d*) accurate milling of the most likely formulations and testing of these for reflection and stability on exposure to ultra-violet light. For this purpose an apparatus was developed which measures accurately the integrated reflection factors and the transmission coefficient of substances in the band from 2800 Å to 3200 Å. This apparatus balances out fluctuations in source intensity, and its readings are independent of the amplification of its amplifier. An exact method of correcting for the multiple reflections between the surfaces of the windows in an absorption cell is described.
Authors.

1021. Reflecting-power measurements in the spectral region 2000 Å to 1300 Å. B. K. Johnson. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 258–264, *May*, 1941.

1022. New lens systems. H. W. Lee. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 130–149, 1941.

SPECTROSCOPY.

1023. Photo-electric spectrophotometry and its use in industry. W. D. Wright. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 36–40, 1941.

1024. Infra-red spectra of polyatomic molecules. H. H. Nielsen. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 41–65, 1941.

1025. Long-wavelength spectra of aldehydes and ketones. I. Saturated aldehydes and ketones. II. Conjugated aldehydes and ketones. H. L. McMurry. *J. Chem. Phys.*, **9**, *pp.* 231–251, *March*, 1941.—Intensity calculations are used to help in deciding which of two theoretically predicted transitions should be identified with the weak longest-wavelength absorption characteristic of the unconjugated $\rangle C = O$ group.—An interpretation of the long-wavelength absorption regions of conjugated aldehydes and ketones is given. The strong regions can be assigned to transitions of the $N \rightarrow V_1$ type known to produce the intense long-wavelength absorption in polyenes. The weak absorption regions, which are characteristic of the carbonyl group, can be explained as arising from the type of transition previously proposed to explain the weak carbonyl absorption in saturated aldehydes and ketones.
Author.

1026. Spectroscopic studies of the simpler porphyrins. II. H. V. Knorr and V. M. Albers. *J. Chem. Phys.*, **9**, *pp.* 197–203, *March*, 1941.—[See Abstr. 3670 (1936).] The molecular absorption coefficients of porphine and 2 aliphatic *ms*-tetrasubstituted porphines and 1 aromatic *ms*-tetrasubstituted porphine, together with their corresponding isomers, have been measured for a portion of the visible region of the spectrum. The curves representing the absorption coefficient as a function of wavelength are shown. Authors.

1027. Spectroscopic evidence for hydrogen bonds: comparison of proton-attracting properties of liquids. III. W. Gordy and S. C. Stanford. IV. W. Gordy. *J. Chem. Phys.*, **9**, *pp.* 204–223, *March*, 1941.—[See Abstr. 1171 (1940).] Data showing the absorption of the OD group of CH_3OD in 77 different solvents are given in a table of positions of the band and shifts from the position of the unperturbed OD absorption band. No correlation is evident between the absorption data and the dielectric constants and dipole moments of the solvents. A relationship was found to exist between the proton-acceptor power of a given atom and the electro-negativities of the atoms adjacent to it in the molecule.—The strengths of deuterium bridges formed between heavy water and 42 different basic solvents are compared by measurements of the perturbations which the solvents produce on the OD vibrational band of heavy water which occurs at 3·59 μ in the vapour and at 4·00 μ in the liquid. The proton-attracting properties of 25 solvents are compared by measurement of the strengths of the H bonds which they form by sharing the proton of HCl. Heavy water was found more satisfactory for strong and moderately weak bases; HCl for extremely weak bases. The shifts which the different liquids produce upon the D_2O band and the HCl band are compared with the shifts which the same solvents produce on the OD vibrational band of CH_3OD. A linear relation was found in each case, with frequent but small variations from linearity. AUTHORS.

1028. Extreme ultra-violet spectra of Ne IV, V and VI. F. W. PAUL AND H. D. POLSTER. *Phys. Rev.*, **50**, *pp.* 424–430, *March* 1, 1941.—An electrical discharge suitable for the excitation of high stages of ionization in gases has been developed. This discharge has been used to excite Ne gas and the resulting emission has been recorded with a 3 m. grazing-incidence vacuum spectrograph. The ionization potentials of Ne IV and Ne V were found to be 96·43 V and 125·8 V, respectively. The ionization potential of Ne VI is estimated to be 157 V. AUTHORS.

1029. Fundamental frequencies of certain halomethanes. II. Raman spectrum of CHF_3. G. GLOCKLER AND W. F. EDGELL. *J. Chem. Phys.*, **9**, *pp.* 224–231, *March*, 1941.—[See Abstr. 2986 (1940).] The Raman spectrum of CHF_3 has been determined and the assignment to the 6 fundamentals is made by considering the intensities and by comparison with the other haloforms. Checks are obtained by 2 independent methods based on the theory of small vibrations. The fundamentals in $CHClF_2$ are revised to harmonize with the data of CHF_3 and are empirically correlated in several spectral sequences. Molar heat capacities are calculated for CHF_3, $CHClF_2$, and $CHCl_2F$ in the range $T=250°K.$ to $T=650°K.$ and compared with experimental values where available. The heat capacities are fitted to empirical equations and a term added to correct to finite pressures by means of the modified Berthelot equation of state. It is shown that these equations are accurate within 5% and are more reliable than thermal data available at present. AUTHORS.

X-RAYS.

1030. Theory of the modified reflection of X-rays by crystals. G. E. M. JAUNCEY. *Phys. Rev.*, **59**, *pp.* 456–458, *March* 1, 1941.—The Bragg formula is examined for the shift in the position of the diffraction max. as the group is turned away from the position for the Laue-Bragg diffraction max. The theory shows that the approximate formula for the shift is the same as that derived on entirely different assumptions by Zachariasen and by Raman and Nath. AUTHOR.

1031. X-ray diffraction maxima at other than Bragg angles. P. KIRKPATRICK. *Phys. Rev.*, **59**, *pp.* 452–455, *March* 1, 1941.—Photographic observations of Mo *Kα* lines internally reflected from (111) planes of diamond show that the angle of deviation is not constant with angle of incidence. Observations of the variation of line intensity and width with angle of incidence do not agree well with the theory. Spectrometer observations of reflections from calcite with slightly ground and with untreated cleavage surfaces upon which monochromatic radiation was incident at angles differing from the Bragg angle show detectable reflection over an 11° range of angles of incidence in the former case, but only 2° in the latter. The large difference between these ranges indicates that disordered crystal particles are the principal source of reflected intensity at other than Bragg angles with the predominant crystal planes in the former case. The presumption is strong that this source has operated as a partial or complete explanation of some of the reflections hitherto reported as anomalous. AUTHOR.

1032. Some useful X-ray data. E. W. PIKE. *J. Appl. Phys.*, **12**, *pp.* 206–209, *March*, 1941.—The measured mass absorption coefficients of Allen and Wrede for H, Be, C, N, O, F, Na, Al, Si, Cl and Br have been fitted to the universal law $\mu/\rho=a\lambda^n+c/(1+0{\cdot}048/\lambda)$, by least squares, and the values of *a*, *n*, and *c* tabulated. The energy distribution in the continuous X-ray spectrum in the range from 20 to 70 kV is presented graphically in a form which permits easy interpolation. AUTHOR.

1033. Radiative X-ray transitions within the *L* shell. D. H. TOMBOULIAN AND W. M. CADY. *Phys. Rev.*, **59**, *pp.* 422–423, *March* 1, 1941.—Whereas *N–N* and *M–M* lines have been observed in the X-ray spectra of several elements, *L–L* lines have not been identified. However, isolated lines of Na (375A), Mg (317A) and Al (290A) reported by Skinner are here designated as L_1–$L_{11,\,111}$. Thus the L_1 term in these elements may now be evaluated and reliable predictions of L_1 may be made for the elements Si to Cr. AUTHORS.

See also Abstracts 908, 927, 928.

HEAT.

CONDUCTION.

1034. Heat conductivity of rubber at low temperatures. A. SCHALLAMACH. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 214–218, *May*, 1941.—The heat conductivity of rubber is measured in the range between liquid-air and room temperatures, employing a mechanically operated cryostat. The heat conductivity shows an abrupt rise between 190° and 220° K. AUTHOR.

1035. Thermal conductivity of liquids. O. K. BATES, G. HAZZARD AND G. PALMER. *Industr. Engng Chem.*, **33**, *pp.* 375–376, *March*, 1941.—This paper presents the results of experimental determinations of the thermal conductivity and the temperature coefficient of thermal conductivity for 12 chlorinated hydrocarbons available in commercial quantities. AUTHORS.

1036. Studies on glass. XVII. The thermal conductivity of glassy and liquid glucose. E. S. GREENE AND G. S. PARKS. *J. Chem. Phys.*, **9**, *pp.* 262–265, *March*, 1941.—[See Abstr. 745 (1936).] The coefficients of thermal conductivity of glassy and liquid glucose have been measured between −77° and +80°C. with a concentric-cylinder apparatus. The results show no irregularity or significant change within the transition or softening region of the glass. AUTHORS.

DILATATION.

1037. Thermal expansion of Al from 0° to 650°C. A. J. C. WILSON. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 235–244, *May*, 1941.—The lattice spacing of Al (*d*) is measured as a function of temperature by means of a high-temperature Debye-Scherrer X-ray camera. The coefficient of expansion is deduced. The systematic and random errors in *d* are each about 0·0001 Å, the error in α from 1% to 2%. AUTHOR.

1038. Crystallization of vulcanized rubber. N. BEKKEDAHL AND L. A. WOOD. *Industr. Engng Chem.*, **33**, *pp.* 381–384, *March*, 1941.—Crystallization has not hitherto been recognized as a factor of practical importance in commercial vulcanized rubber products. In cold climates some rubber products have been observed to undergo slowly a great increase in rigidity and permanent set. The present investigation, reporting the crystallization of unstretched specimens of vulcanized rubber of low sulphur content, offers a basis for the explanation of such phenomena. AUTHORS.

THERMOCHEMISTRY.

1039. Formation of half-acetal. K. L. WOLF AND K. MERKEL. *Z. phys. Chem. A*, **187**, *pp.* 61–65, *Aug.*, 1940. *In German.*—By means of the precision calorimeter previously described [Abstr. 2698 (1937)] the heat of reaction of the half-acetal formed by the union of propanol and propion aldehyde was measured. At 20°C. the heat of reaction was found to be 8·2 ± 1 kcal./mole and the mixing heat 1·30 kcal./mole. [See also Abstr. 2563 (1935).] R. N.

1040. Spontaneous ignition of hydrocarbons. Zones of non-ignition. C. W. SORTMAN, H. A. BEATTY AND S. D. HERON. *Industr. Engng Chem.*, **33**, *pp.* 357–360, *March*, 1941.—Spontaneous-ignition temperatures in air, and the corresponding time-lags, have been determined for a variety of hydrocarbons at atmospheric pressure by the oil-drop or Moore method, using a steel crucible and different air flow rates and liquid drop sizes. Under some conditions of air and liquid feed the readily ignited hydrocarbons, such as cetane and heptane, show 2 separate temperature zones of non-ignition above the min. ignition temperature, a behaviour heretofore unobserved; under other conditions one or both of these zones are eliminated. The conditions of air and liquid feed also have a marked effect on the ignition time-lag, especially at low temperatures. Addition of tetra-ethyl lead completely inhibits ignition up to about 454°–538°C. AUTHORS.

THERMODYNAMICS.

1041. Theory of the thermodynamic properties of large molecules. R. E. POWELL, C. R. CLARK AND H. EYRING. *J. Chem. Phys.*, **9**, *pp.* 268–273, *March*, 1941.—It is shown that the theory of motion of segments provides an explanation for a variety of thermodynamic properties: (*a*) the change of melting temperature with chain length;

(*b*) the abnormally large increase in the osmotic pressure of large linear polymers with concentration; (*c*) the abnormally large vapour pressure of solvent above concentrated solutions of such polymers; (*d*) the fact that surface tension becomes independent of the mol. wt. for long molecules; (*e*) the volume and entropy changes of swelling of polymers. AUTHORS.

1042. Calculating Beattie-Bridgeman constants from critical data. S. H. MARON AND D. TURNBULL. *Industr. Engng Chem.*, **33**, *pp.* 408–410, *March*, 1941.—Expressions are derived relating the Beattie-Bridgeman constants of any gas to those of a reference gas in terms of critical pressure and critical temperature only. The constants thus calculated for various gases are used to evaluate the compressibilities of these gases, and the calculated results are compared with observed data and with the van der Waals equation. Compressibilities calculated by the method described agree satisfactorily with observed data over a wide temperature and pressure range and are, in general, superior to the results of the van der Waals equation at all temperatures except in the interval $T_r = 1{\cdot}00\text{–}1{\cdot}25$, where T_r is the reduced temperature. [See Abstr. 627 (1941).] AUTHORS.

1043. Equations of state. J. A. BEATTIE AND W. H. STOCKMAYER. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 195–229, 1941.

See also Abstract 1080.

VAPORIZATION AND CONDENSATION.

1044. Line-co-ordinate chart for vapour pressures of organic solvents. D. S. DAVIS. *Industr. Engng Chem.*, **33**, *p.* 401, *March*, 1941.

1045. Evaporation nomograph. D. S. DAVIS. *Industr. Engng Chem.*, **33**, *p.* 319, *March*, 1941.

ACOUSTICS.

1046. Sound. E. G. RICHARDSON. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 1–26, 1941.

1047. Musical acoustics. E. G. RICHARDSON. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp.* 27–35, 1941.

1048. Study of supersonic waves in liquids with the Jamin interferometer. R. BÄR. *Helv. Phys. Acta*, **13**, 3, *pp.* 193–203, 1940. *In German.*—Buss [Abstr. 5011 (1938)] found that the sound waves affect the position and intensity of the interference bands. The effect has been examined with improved apparatus, and an explanation is given which is based on Raman and Nath's theory, according to which the light beams interfering in the Jamin apparatus have amplitudes 1 and $J_0(x)$ (the Bessel function of zero order). The interference phenomena derived for the frequency range 1 500 to 7 500 kc./s. correspond qualitatively with the observations in all respects and a quantitative confirmation of the theory is obtained when a frequency of 3 000 kc./s. in water is employed. G. E. A.

1049. Specific normal impedances and sound-absorption coefficients of materials. P. E. SABINE. *J. Acoust. Soc. Amer.*, **12**, *pp.* 317–322, *Jan.*, 1941.—Reverberation measurements on identical samples in large chambers have been carried out at the Riverbank and the Johns-Manville laboratories and at the Bureau of Standards. The results obtained show agreement within the limits of errors of measurement for frequencies between 512 c./s. and 2 048 c./s. inclusive, while at $f \leq 256$ c./s. measured values are affected by individual room conditions. Correlation between acoustical impedance measurements and reverberation measurements can be effected by using the absolute value of the impedance as a real quantity and assigning an experimentally determined value to the average value of the cosine of the angle of incidence in a given room. In large reverberation chambers the measured reverberation coefficients approximate to the absorptivity at normal incidence for $f < 256$ c./s., while for $f \geq 512$ c./s. the coefficients approximate to the absorptivity for random incidence. A. W.

1050. Absorption of strips; effects of width and location. L. G. RAMER. *J. Acoust. Soc. Amer.*, **12**, *pp.* 323–326, *Jan.*, 1941.—Measurements carried out at the Riverbank laboratories show that, for strips of absorbent material placed away from the edges of wall areas, the narrower the strips the greater the effectiveness or apparent absorption coefficient of the material. For strips placed at the edge of a wall area the absorption/frequency curve is a function of the width of the strip. Further, the optimum placement of narrow strips of the absorbent material is governed by the frequency of the tone under consideration and the width of strip employed. The results tend to show that it might be possible in certain cases to make the l.f. absorption in a room equal to or greater than that for higher frequencies. A. W.

1051. Transmission loss of non-porous plate having multiple resonant points. S. Kawashima. *J. Acoust. Soc. Amer.*, **12**, *pp.* 332–334, *Jan.*, 1941.—Measurements of the absorption of a glass plate, an iron plate and a wooden partition wall, show that the two latter possess many resonance points. The sound reduction factor is, in general, reduced near the resonant points. It may therefore be preferable to use materials with multiple resonance peaks in order to increase the transmission loss, rather than to use materials possessing a single sharp resonance. A. W.

1052. Reflection of sound pulses by convex parabolic reflectors. F. G. Friedlander. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 134–149, *April*, 1941.—Lamb's discussion of the reflection of a train of simple harmonic waves by a convex paraboloid of revolution and by a parabolic cylinder is extended to the reflection of plane waves of arbitrary form. When a suitable time scale is introduced, the reflected wave is the same at all points on any paraboloid (or parabolic cylinder) confocal with the reflector. G. E. A.

1053. Sound-level meter performance. J. E. Tweeddale. *J. Acoust. Soc. Amer.*, **12**, *pp* 421–426, *Jan.*, 1941.—When measuring a given noise there is frequently a serious lack of agreement and consistency among different types of sound-level meters, though presumably calibrated to the same reference point and otherwise fulfilling certain standardized performance requirements. This disagreement is the result of a number of factors primarily connected with the limitations of the tentative standards adopted for the performance of sound-level meters when applied to industrial noise problems. Suggestions are made relative to the elimination of the tolerable deviations in frequency response of the standards that should assist materially in improving the present situation. Improvements contributing to enhanced stability and constancy of performance of sound-level meters are briefly described. A. W.

1054. Phonograph pick-ups for lateral-cut records. L. Fleming. *J. Acoust. Soc. Amer.*, **12**, *pp.* 366–373, *Jan.*, 1941.—A discussion is given of the relation of stylus and groove section, of stylus reaction and tracking, the proportioning of the effective mass and the compliance of the system, damping and the pinch effect. A magnetic pick-up is described which plays commercial shellac pressings cleanly at 20 g. pressure. The armature is a strip of silicon steel $0{\cdot}014 \times 0{\cdot}1 \times 0{\cdot}35$ in. and is mounted in a 2-spring suspension of the type devised by Harrison which allows both lateral and vertical freedom to the stylus. The weight of the armature and stylus is about 70 mg., the stiffness of the system about $1{\cdot}4 \times 10^6$ dynes/cm. and the resonant frequency 1 050 c./s., giving an effective mass of 33 mg. The pick-up was found to give a much greater output and less hum than the inductor or ribbon microphone variety. A. W.

1055. Method of measuring audio-frequencies. D. Lewis and P. E. Griffith. *J. Acoust. Soc. Amer.*, **12**, *pp.* 412–414, *Jan.*, 1941. [Abstr. 669B (1941).]

1056. Measurements of orchestral pitch. O. J. Murphy. *J. Acoust. Soc. Amer.*, **12**, *pp.* 395–398, *Jan.*, 1941. [Abstr. 752B (1941).]

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

1057. Electrical discharges in gases and their applications. I. V. J. Francis and H. G. Jenkins. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7**, *pp* 230–302, 1941.

See also Abstract 1028.

CONDUCTION IN SOLIDS AND LIQUIDS.

1058. Temperature coefficient of the conductance of KCl in H_2O–D_2O mixtures. V. K. La Mer and F. C. Nachod. *J. Chem. Phys.*, **9**, *pp.* 265–268, *March*, 1941.—The temperature dependence of the equivalent conductance of 0·02 molar KCl was studied at 5°, 25° and 45°C., as a function of the deuterium content of the solvent. The new data at 5° and 45° exhibit the same sag type of curve when plotted against the deuterium fraction of the solvent as observed previously by La Mer and Baker for 0·01*M* KCl at 25°C. Authors.

1059. Electrical conduction in dielectric liquids. R. W. Dornte. *Industr. Engng Chem.*, **32**, *pp.* 1529–1534, *Nov.*, 1940.—The current/voltage relations at high electrical gradients are obtained for dry, gas-free heptane and benzene at 23°C. in both uniform and non-uniform electric fields. A comparison of the experimental results with the requirements of the thermionic emission theory of conduction is made by means of the slopes of the current/voltage curves. The experimental slope is generally greater than the calculated value, indicating that the electron emission is concentrated on sharp points on the electrode surface.

This conclusion is substantiated by experiments showing that the currents are not proportional to the electrode areas in uniform electric fields. The current/voltage curves are dependent upon the nature of the electrode surfaces and are influenced by the polish and by absorbed gases, as well as by materials removed from the cell by repeated washings with the purified benzene or heptane. The current/voltage characteristics of benzene and heptane are reproducible in a given cell but are difficult to reproduce in different cells. The cold-cathode emission of electrons is suggested as a possible mechanism for the electrical conduction in dielectric liquids. The effect of temperature on the current/voltage characteristics is in agreement with the cold-cathode mechanism of conduction. AUTHOR.

See also Abstract 1079.

DIELECTRICS AND CAPACITANCE.

1060. Theory of insulating materials. P. BÖNING. *Kolloid Zschr.*, **92**, *pp.* 136–141, *Aug.*, 1940. *In German.*—[Abstr. 660B (1941).]

1061. Dielectric loss in thin films of insulating liquids. C. G. GARTON. *J. Instn Elect. Engrs*, **88**, *Part III*, *pp*, 23–30, *March*, also *Part II*, *pp.* 103–120, *April*, 1941.—[Abstr. 502B (1941).]

1062. Discharges in insulation under a.c. stresses. A. E. W. AUSTEN AND S. WHITEHEAD. *J. Instn Elect. Engrs*, **88**, *Part III*, *pp.* 18–22, *March*, *also Part II*, *pp.* 88–92, *April*, 1941.—[Abstr. 504B (1941).]

1063. Dielectric constants of aliphatic ketones. R. H. COLE. *J. Chem. Phys.*, **9**, *pp.* 251–257, *March*, 1941.—The dielectric constants and densities of 8 aliphatic ketones were determined over nearly the entire temperature range of the liquid phase. The results lead to the conclusion that dipole-dipole coupling is the important factor in determining the dielectric constants of these liquids. The data show definite departures from Onsager's theory. Use of the Onsager formula to calculate dipole moments from dielectric-constant data on the pure polar liquids, as suggested by Böttcher, is not justified in the case of the ketones and is to be undertaken with caution in other cases. It is not possible to attribute the departures for the ketones to proton bonding. The results are, however, consistent with Kirkwood's more detailed theory. It is further shown that dielectric constants of normal aliphatic alcohols are consistent with Kirkwood's theory as applied to a crude model of the liquid structure of these alcohols. AUTHOR.

1064. Dielectric properties of organic compounds. S. O. MORGAN AND W. A. YAGER. *Industr. Engng Chem.*, **32**, *pp.* 1519–1528, *Nov.*, 1940.—The dielectric constants of polar liquids should be directly derivable from their chemical structure according to simple dielectric theory, but for many liquids the observed values differ greatly from those thus calculated. These departures may be due to (*a*) association or interaction, causing the molecules to act as associated pairs or aggregates in which the net electric moment is low because dipoles are so directed as to oppose one another; or (*b*) the effect of internal friction or viscosity in restricting the motion of dipoles. In the solid state, where, on the basis of simple theory, no rotation would be expected and consequently low dielectric constants should be the rule, it is shown that there are many cases of high dielectric constant. The more nearly the molecules approach a simple geometrical form such as a sphere, circle or rod, the more likelihood there is that they will be able to rotate. In plastics the polymer molecules as a whole are too large to rotate, but motion of polar groups may be possible. Such motions appear to be sufficient to explain observed values of dielectric constant in plastics. AUTHORS.

1065. Electrical properties of solids. VI. Dipole rotation in high polymers. R. M. FUOSS. **VII. System polyvinyl chloride-diphenyl.** R. M. FUOSS. **VIII. Dipole moments in polyvinyl chloride-diphenyl systems.** R. M. FUOSS AND J. G. KIRKWOOD. *J. Amer. Chem. Soc.*, **63**, *pp.* 369–394, *Feb.*, 1941.—The properties of several plastics were examined at 60–10000 c./s. over a wide temperature range. Characteristic max. in absorption and dispersion in dielectric const. depend on size and strength of polar group, length and flexibility of bonds, and nature and amount of plasticizer. The fundamental mechanism of a.c. response is dipole rotation in a medium of high viscosity. A transition temperature is found for polyvinyl chloride at which internal melting occurs.—The general results are confirmed for the system polyvinyl chloride diphenyl. Low-temperature absorption is reduced and eventually eliminated by the addition of a second component.—A method is given whereby the distribution of times of relaxation can be calculated from the loss-factor/frequency curve. The average moment per monomer unit of a linear polar polymer of type $(-CH_2\cdot CHX-)_m$, assuming free rotation, is $\mu_0\sqrt{3/2}$ where μ_0 is the moment of the equivalent group in free space. ED.

1066. Bond moment additivity and the electric moments of some halogenated hydrocarbons. A. A. MARYOTT, M. E. HOBBS AND P. M. GROSS. *J. Amer. Chem. Soc.*, **63**, *pp.* 659–663, *March*, 1941. —The electric moments of 7 hydrocarbons have been measured in the gaseous state. The trend in the moment per bond for a series in which a central atom has a repeated substitution taking place on it has been associated with the changing availability of the electrons of the central atoms to the attached groups. The rôle of induction and resonance is apparently rather small except in the case of *cis*-dichloroethylene. In this case resonance is probably the controlling factor. AUTHORS.

ELECTROCHEMISTRY.

1067. Theory of the hydrogen overvoltage. J. A. V. BUTLER. *J. Chem. Phys.*, **9**, *pp.* 279–280, *March*, 1941.—Remarks on previous papers [Abstr. 645 (1941)].

1068. Thermodynamic ionization constants of sulphurous acid at 25°C. H. V. TARTAR AND H. H. GARRETSON. *J. Amer. Chem. Soc.*, **63**, *pp.* 808–816, *March*, 1941.—The values obtained are $1{\cdot}72 \times 10^{-2}$ for the first ionization constant and $6{\cdot}24 \times 10^{-8}$ for the second. The first of these values is in fair agreement with previous determinations made by conductivity measurements, while the second is only in qualitative agreement with other reported values obtained by much less accurate methods. The general behaviour of glass electrodes in sulphite solutions is described. AUTHORS.

1069. Use of dropping mercury electrode as indicator electrode in poorly poised systems. I. M. KOLTHOFF AND E. F. ORLEMANN. *J. Amer. Chem. Soc.*, **63**, *pp.* 664–667, *March*, 1941.—The oxidation potential of poorly poised systems can be determined with the dropping Hg electrode, if proper correction is made for the residual current. Neglect of this correction may lead to large errors. When H ions are produced at the electrode during an electrolysis the surface concentration can be calculated by a proper consideration of the diffusion and current relations. Equations are derived which are in agreement with the experimental results. AUTHORS.

1070. Theory of glass electrode. V. Influence of negative ions. M. DOLE, R. M. ROBERTS AND C. E. HOLLEY, JR. *J. Amer. Chem. Soc.*, **63**, *pp.* 725–730, *March*, 1941.—The influence of fluoride, chloride, borate and hydroxide ions on the glass electrode is studied. No negative ion as such appears to affect the alkaline errors of the glass electrode, but in certain cases these errors in solutions of high *p*H are greatly increased if the glass surface is exposed to 1*N* fluoride solutions having *p*H values lower than 7·0. A new Beckman Na-error-free glass electrode has been investigated in 1*N* Na solutions. The Na errors are materially reduced by this new kind of glass. AUTHORS.

1071. Electrolytic dissociation of citric acid in NaCl solutions. B. ADELL. *Z. phys. Chem. A*, **187**, *pp.* 66–78, *Aug.*, 1940. *In German.*—By means of diffusion-free cells the 3 concentration constants of citric acid in NaCl solutions of ionic strength of 0·1 to 3·0 were determined at 18°C. using an electrometric method. These values and the thermodynamic dissociation constants of the acid, as determined by previous investigators, are used for calculating activity functions of the ions and undissociated molecules. The ion-concentration values are compared with previous results. The activity functions and the phenomena connected with the dissociation of citric acid are discussed and the negative logarithm of the electrical part of the activity coefficient of citric acid is compared with that for several other acids in NaCl solutions. R. N.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

1072. Magnitude of electronic charges. A. LANDÉ. *Phys. Rev.*, **59**, *pp.* 434–435, *March* 1, 1941.—Classical values of rest energy and wave period of a charged particle yield a value for Sommerfeld's fine-structure const. at variance with experiments. This discrepancy is briefly discussed. ED.

1073. Capture cross-section for thermal neutrons of Cd, Li, B, Ba, Hg and H. E. L. HARINGTON AND J. L. STEWART. *Canad. J. Res. A*, **19**, *pp.* 33–41, *March*, 1941.—A comparison method of measuring, by using solutions, the capture cross-sections for thermal neutrons is described. The chief advantages are directness, simplicity and freedom from uncertainties of direction of path or magnitude of the scattering effect. The method is best suited to nuclei of large cross-sections. Assuming the well checked value for the Cd nucleus to be correct, the capture cross-sections of certain other nuclei were determined. The results for Ba and for H differ widely from values previously published. AUTHORS.

1074. Deuteron bombardment of gold. R. S. KRISHNAN. *Proc. Camb. Phil. Soc.*, **37**, *pp.* 186–193, *April*, 1941.—The reactions found to take place when gold is bombarded with deuterons of energy up to 9·1 eMV are the formation of 2·7-day Au^{198} by a (*d-p*) process and of 32 hr. Hg^{198*} in a metastable state by a (*d-n*) process. The β-ray and γ-ray energies associated with each radioactivity have been measured by absorption methods. Excitation functions for the two reactions have been determined and the results have been compared with those to be expected on theoretical grounds. AUTHOR.

1075. Burst production by mesotrons. R. F. CHRISTY AND S. KUSAKA. *Phys. Rev.*, **59**, *pp.* 414–421, *March* 1, 1941.—Assuming that, under great absorbing thicknesses, cosmic-ray bursts are cascade showers from high-energy soft secondaries produced in the shielding matter by mesotron-electron collisions and by mesotron bremsstrahlung, the frequency of burst production as a function of burst size is calculated. For the mesotron of spin 1 and moment $e\hbar/2\mu c$, the previously calculated knock-on formulae used are supplemented by calculations of the bremsstrahlung. AUTHORS.

1076. Neutron-proton interaction. W. RARITA AND J. SCHWINGER. *Phys. Rev.*, **59,** *pp.* 436–452, *March* 1, 1941.—A phenomenological theory is developed in which simplified rectangular-well potentials are adopted, whose constants are determined to fit the binding energy and quadripole moment of the deuteron and the scattering of slow neutrons in H. The effects investigated include the magnetic moment of the deuteron, the scattering of neutrons in H, the radiative capture of slow neutrons, and the photo-disintegration of the deuteron. The theory adequately represents the experimental data, with the exception of the photomagnetic disintegration of the deuteron which would seem to require a detailed knowledge of the charge-bearing field. AUTHORS.

1077. Interaction of γ-rays with mesotrons. R. F. CHRISTY AND S. KUSAKA. *Phys. Rev.*, **59,** *pp.* 405–413, *March* 1, 1941.—Differential cross-sections for the production of a mesotron pair by a γ-ray and for the bremsstrahlung of a mesotron in the electromagnetic field of a nucleus have been calculated. Both the Proca wave field and the Kemmer matrix formulations of the theory for mesotrons of unit spin and unit magnetic moment were used. These differential cross-sections have been integrated in the limit where the energies of the mesotrons and photon are large compared with the rest energy of the mesotron. Since considerations of the validity of the Born approximation method used show that the leading terms in the cross-sections lose their validity before they become dominant, terms of lower order which give cross-sections increasing only logarithmically with the energy have been calculated by the method of virtual quanta. AUTHORS.

1078. Electron microscopes of high magnification. O. KLEMPERER. *Phys. Soc., Lond., Rep. Progr. Phys.*, **7,** *pp.* 107–129, 1941.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

1079. Hall effect and other physical properties of the Cu-Sn system of alloys. G. G. ANDREW-ARTHA AND E. J. EVANS. *Phil. Mag.*, **31,** *pp.* 265–282, *April,* 1941.—Previous work [Abstr. 1665 (1929)] is continued by an investigation of 34 alloys of different compositions between that of pure Cu and Sn and well distributed over the various phases for densities, resistivities, temperature coefficients of resistance, thermo-electric powers and Hall coefficients. The alloys were prepared from pure materials and subjected to a process of annealing so that they were in a stable reproducible state at room temperature. Tables of data are included, and these are discussed in relation to the position of the phase boundaries. Addition of Sn to Cu is accompanied by a steady increase in the resistivity until a composition of ca. 14% Sn is reached when the slope of the curve changes. In the $(\alpha+\delta)$ phase a max. of resistivity is reached at the composition corresponding to the intermetallic compound Cu_4Sn, and a min. at Cu_3Sn. No general statement can be made concerning the effect of annealing on the resistivities of the alloys. Although the Hall coefficients of both Cu and Sn are negative, those in the neighbourhood of Cu_4Sn and Cu_3Sn are positive, and it appears that the Hall coefficient is intimately connected with the structure and composition of the alloys. H. H. Ho.

MAGNETISM AND ELECTROMAGNETISM.

1080. Magnetism and the third law of thermodynamics. Magnetic susceptibility, adiabatic change of temperature on magnetization and heat capacity of $NiSO_4{\cdot}7H_2O$. J. W. STOUT AND W. F. GIAUQUE. *J. Amer. Chem. Soc.*, **63,** *pp.* 714–722, *March,* 1941.—The heat capacity of $NiSO_4{\cdot}7H_2O$ was measured by means of an amorphous-carbon thermometer heater from 1° to 15°K. The adiabatic change of temperature on magnetization was measured over the same temperature range and in fields up to 8 000 gauss. The differential magnetic susceptibility was measured by the method of opposed identical coils to eliminate effects due to fluctuations in the field of the magnet. The ordinary magnetic susceptibility was calculated from the differential susceptibility. The susceptibility was also calculated from the observed heat capacity and temperature change on magnetization, using equations based only on thermodynamics. The values so calculated are more reliable than the directly observed susceptibilities, which agree within the limit of error. The electronic system makes a large contribution to the heat capacity at temperatures where the lattice heat capacity is unimportant. A max. in the heat capacity occurs near 1·8°K. AUTHORS.

1081. Measurement of adiabatic differential magnetic susceptibility near 1° abs. Heat capacity of gadolinium phosphomolybdate tridecahydrate from 0·17° to 4·7° abs. W. F. GIAUQUE, J. W. STOUT,

C. J. EGAN AND C. W. CLARK. *J. Amer. Chem. Soc.*, **63**, *pp.* 405–410, *Feb.*, 1941.—The sample was cooled by adiabatic demagnetization and energy was introduced by means of an amorphous-carbon thermometer heater. Apparatus is described for the measurement of adiabatic differential magnetic susceptibility, while the sample is in a field with the usual fluctuations caused by a motor-generator supply of current. The intensity of magnetization along 6 adiabatic paths is given as a function of magnetic field strength. AUTHORS.

1082. Theory of volume magnetostriction. R. SMOLUCHOWSKI. *Phys. Rev.*, **59**, *pp.* 309–317, *Feb.* 1, 1941.—Volume magnetostriction is considered on the basis of the molecular-field theory. The dependence of saturation magnetization on temperature for coupled and uncoupled electrons is assumed to be given by a Brillouin function. With the experimental data on the magnetostriction of iron this method leads to values for the molecular-field constant, its dependence on the relative change of volume, and the dependence on volume of the saturation magnetization at $T = 0$. The values agree with those obtained from magneto-caloric measurements. Another check is made by considering the magnetic specific heat. All quantitative checks, including the probable change of the Curie point under pressure, are more satisfactory if electrons coupled in pairs are assumed than if uncoupled electrons are considered. AUTHOR.

MEDICAL RADIOLOGY AND ELECTROLOGY.

1083. Borderland problems in biology and physics. I. Application of physical methods to the investigation of biological and biochemical problems. J. R. LOOFBOUROW. *Rev. Mod. Phys.*, **12**, *pp.* 267–358, *Oct.*, 1940.

*** 1084. Integrating photo-electric meter.** J. B. H. KUPER, F. S. BRACKETT AND M. EICHER. *Rev. Sci. Instrum.*, **12**, *pp.* 87–90, *Feb.*, 1941.—Integrating meters for measuring ultra-violet energy have been developed which are unaffected by weather conditions and have been operated in the field without skilled attention for over 2 years. They have also proved useful in the laboratory, providing radiation dosage measurement within 1 or 2%. These employ special phototubes with a condenser and cold-cathode trigger tube sealed in an extension of the glass envelope, thereby eliminating moisture as a source of leakage. A suitable registering circuit for counting the pulses from the trigger tube is described. Characteristics are given of typical photocells useful in erythemal and bactericidal measurements. AUTHORS.

PHOTO-ELECTRICITY.

1085. Demonstration of the photo-effect by means of the glow discharge lamp. B. A. METZGER. *Phys. Z.*, **41**, *pp.* 508–510, *Nov.* 15, 1940. *In German.*—The author gives experimental curves showing the dependence of the photo-current of a glow discharge lamp on the voltage applied at daylight and when illuminated by a 100 W metal-filament incandescent lamp. The glow discharge lamp is also well suited for photometric purposes as there is a strict linear relation between illumination and current. Especially for demonstration purposes the glow discharge lamp may replace a photocell. R. N.

1086. Photo-electric work functions of (100) and (111) faces of Ag single crystals and their contact potential difference. H. E. FARNSWORTH AND R. P. WINCH. *Phys. Rev.*, **58**, *pp.* 812–819, *Nov.* 1, 1940.—The equilibrium value of the work function for the (100) face is 4·81 ± 0·01 eV, and that for the (111) face is 4·75 ± 0·01 eV. These values were obtained after heating for more than 2000 hrs. at various temperatures up to visible red heat. Values of the measured contact p.d. obtained at frequent intervals during the outgassing agreed with the differences of the photo-electric work functions to within ± 0·01 eV. The apparatus permitted deposition of Ag from the vapour state on to the crystal faces, after 2 previous distillations of the Ag had been made to eliminate gas effects. Presence of contamination complicated the results following deposition, but the deposited Ag gave a more gas-free surface than is obtained on heating alone. The rate of return of gas to the surface following the deposit was determined by a comparison of the experimental results with a theory presented by Emslie. The results are explained by postulating that long heating of the crystals produced a stable gas configuration of a mono-layer on their faces, and that deposition of a gas-free layer of Ag produced a surface free of most, if not all, of this layer of gas. The work function of the gas-free surface is 0·09 ± 0·03 eV less than that of the underlying structure previous to deposit. AUTHORS.

1087. Behaviour of the foreign metal particles in the composite photo-cathode. S. ASAO. *Phys.-Math. Soc. Japan, Proc.*, **22**, *pp.* 448–486, June, 1940.—Experiments and discussion on (1) the construction of the composite cathode, (2) selective emission humps in the spectral sensitivity curve, (3) effect of foreign metal particles on thermionic emission. It is shown that, for composite photo-cathodes of Ag_2O films deposited on activated cathodes of Cs-Cs_2O, Cs and Ag-(Ag), sensitivity depends on the film thickness. The photo-electric emission may be increased or decreased according to the film thickness and the temperature of condensation. Such films have an electrical resistance of about 120Ω/cm^2. along the surface and contain reduced Ag particles similar to those observed in photographic film. With Cu films condensed on Cs-Cs_2O, Cs and Cu-(Cu), similar behaviour is observed. Such a cathode shows a characteristic emission at 600mμ corresponding to the characteristic reflection of Cu. Experimental details are given and a photomicrograph is reproduced. Comparison is made of the behaviour of thick photo-cathodes with and without reduced Ag particles. The work function is independent of the thickness but Richardson's constant *A* decreases if Ag atoms are present.

F. C. C.

THERMIONICS.

∗**1088. Energy losses attending field current and thermionic emission of electrons from metals.** G. M. Fleming and J. E. Henderson. *Phys. Rev.*, **58,** *pp.* 887–894, *Nov.* 15, 1940.—The losses were measured in the same experimental tube. This was accomplished by observing the thermal e.m.f. in a junction from which the emission currents were drawn. No measurable temperature change was observed for field emission up to thermionic temperatures. For thermionic emission temperature changes were observed which, when correlated with the power losses from the filament as a function of temperature, yield a calorimetric value for the work function of W of 4·46 ± 0·09 eV. A theoretical expression is given for the average net energy loss per electron emitted in thermionic and field current emission. The experiment gives strong additional evidence that in field emission the electrons escape by penetrating rather than by surmounting the surface potential barrier as in thermionic emission.

Authors.

1089. Initial velocity currents in thermionic valves. J. A. Darbyshire. *Proc. Phys. Soc., Lond.*, **53,** *pp.* 219–232, *May*, 1941.—The electrons emitted from a thermionic cathode possess enough energy to enable them to reach other electrodes in the system providing the opposing potential is not too great. The current flowing across to any electrode to which no actual potential is being applied is referred to as the initial velocity current from the cathode to that electrode. The magnitude of this current depends on the temperature of the emitting cathode, the contact p.d. between the cathode and the collecting electrode, and several other features. Experimental results are given which show the relative importance of these effects on the magnitude of the initial velocity current.

Author.

THERMO-ELECTRICITY.

1090. Response of sputtered thermocouples to interrupted radiation. L. Harris and A. C. Scholp. *J. Opt. Soc. Amer.*, **30,** *pp.* 519–522, *Nov.*, 1940.—The anomalous behaviour of Bi/Te couples is observed. These couples, when used in conjunction with a l.f. amplifier, are more sensitive than wire thermocouples used with the most sensitive galvanometers but without multipliers. **Erratum,** *ibid.*, **31,** *p.* 25, *Jan.*, 1941.

Authors.

See also Abstract 1079.